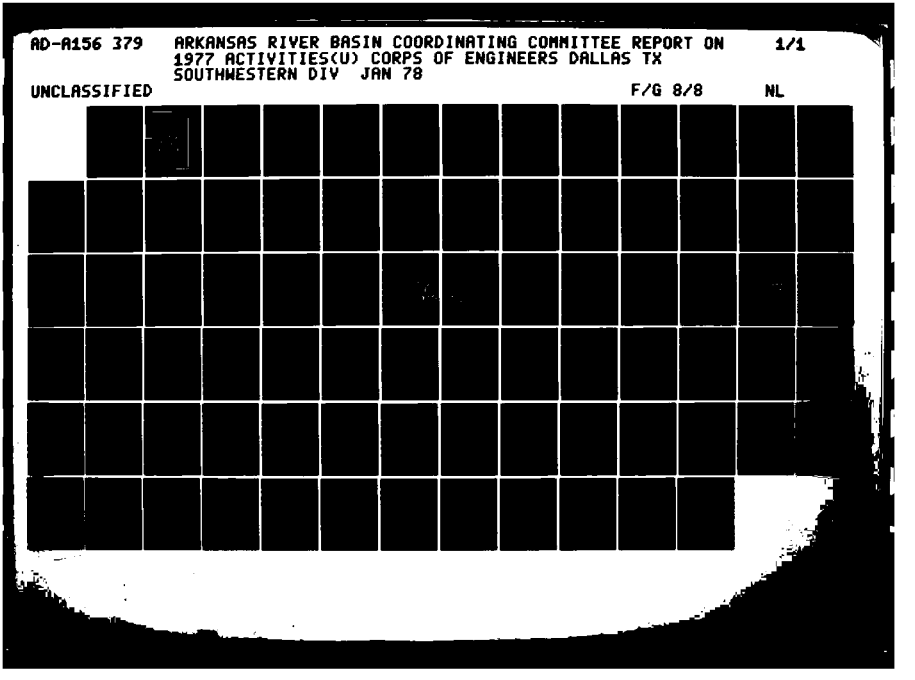
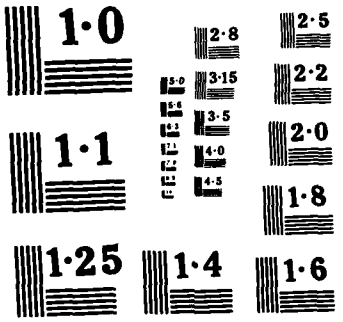

AD-A156 379 ARKANSAS RIVER BASIN COORDINATING COMMITTEE REPORT ON 1977 ACTIVITIES(U) CORPS OF ENGINEERS DALLAS TX SOUTHWESTERN DIV JAN 78
1/1
UNCLASSIFIED
F/G 8/8
NL



Report on 1977 Activities

(3)

ARKANSAS RIVER BASIN COORDINATING COMMITTEE

U.S. ARMY CORPS OF ENGINEERS
SOUTHWESTERN DIVISION
Reservoir Control Center

January 1978

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Report on 1977 activities Arkansas River Basin Coordinating Committee		5. TYPE OF REPORT & PERIOD COVERED Annual 1977 6. PERFORMING ORG. REPORT NUMBER NA
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) NA
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Corps of Engineers, Southwestern Division; Reservoir Control Center		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NA
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE January 1978 13. NUMBER OF PAGES 25 p. : plates & exhibit
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE NA

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

The Arkansas River Basin Coordination Committee consists of official representatives of the following State and Federal agencies--States: Kansas, Oklahoma, and Arkansas. Federal: Corps of Engineers, Department of the Interior, Federal Power Commission, Soil Conservation Service and Southwestern Power Administration

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fish and wildlife enhancement
Flood control
Navigation
Power production
Recreation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is prepared in January of each year to summarize the actual regulation of the Arkansas River Basin reservoirs and navigation system for the previous calendar year. It provides members historical data to use in appraising the results of the past year's regulations and can be used in communicating with their agencies. The report also contains a general summary of planned activities for the coming year.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

The Arkansas River Basin Coordinating Committee consists of official representatives of the following State and Federal Agencies:

STATES

Kansas

Oklahoma

Arkansas

FEDERAL

Corps of Engineers

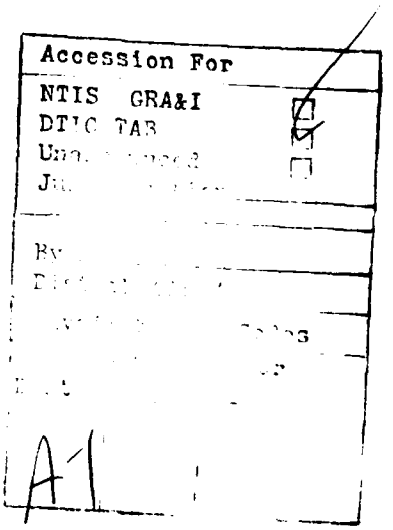
Department of the Interior

Environmental Protection Agency

Federal Power Commission

Soil Conservation Service

Southwestern Power Administration



ARKANSAS RIVER BASIN COORDINATING COMMITTEE
REPORT ON 1977 ACTIVITIES

PLATES

EXHIBITS

ARKANSAS RIVER BASIN COORDINATING COMMITTEE
REPORT ON 1977 ACTIVITIES

I. PURPOSE AND SCOPE

The Arkansas River Basin Coordinating Committee was organized on 20 March 1970. The purpose of this committee is to provide coordination between state and Federal agencies in the regulation of the water resources of the Arkansas River Basin downstream from Great Bend, Kansas. The Committee requested that a report be prepared each calendar year to provide a summary of the regulation activities for the past year.

The report, prepared in January of each year, summarizes the actual regulation of the Arkansas River Basin reservoirs and navigation system for the previous calendar year. It provides members historical data to use in appraising the results of the past year's regulation and can be used in communicating with their agencies. The report also contains a general summary of planned activities for the coming year.

II. INTRODUCTION

A. The Basin. The Arkansas River Basin has a drainage area of 160,533 square miles above the mouth of the White River. From its source on the eastern face of the Rocky Mountains near Leadville, Colorado, the Arkansas River flows southeasterly through Colorado, Kansas, Oklahoma, and Arkansas, to join the Mississippi River at a point about 575 miles upstream from the head of Passes, Louisiana. From its source at about elevation 14,000 feet, msl, the fall of the river ranges from 110 feet per mile near Leadville, Colorado, to 2.2 feet per mile at Tulsa, Oklahoma, and 0.4 foot per mile near the mouth. Major tributaries of the Arkansas River are the Salt Fork of the Arkansas, Cimmaron, Verdigris, Grand (Neosho), Illinois, Canadian, Poteau, Petit Jean and Fourche La Fave Rivers. Plate 1 shows the basin and location of the existing projects.

The upper portion of the basin in Colorado is mountainous and the stream flows through deep gorges and narrow valleys with steep gradients. Below Pueblo, Colorado, the valleys begin to widen and the gradient decreases. Below Great Bend, Kansas (river mile 873.2), the river is crooked and subject to shifting channels. Below the mouth of the Verdigris River, the bank stabilization and channel rectification works now provide a stable channel, suitable for modern barge traffic. Former river channels can be seen several miles from the present stabilized river channels.

The mean annual precipitation ranges from 15 inches in the western portion of the basin to 52 inches at the mouth. The greatest amount of precipitation occurs in late spring and early summer in the western portion of the basin and in late winter and early spring in the eastern portion of the basin. The normal precipitation for selected stations is shown in table 1. The mean annual snowfall ranges from 21 inches near Dodge City, Kansas, to 3 inches in the eastern portion of the basin.

TABLE 1

NORMAL PRECIPITATION

(1941-1970)

	DODGE CITY, KS	WICHITA KS	TULSA OKLA	FORT SMITH ARK	LITTLE ROCK ARK
January	0.50	0.85	1.43	2.38	4.24
February	0.63	0.97	1.72	3.20	4.42
March	1.13	1.78	2.52	3.64	4.93
April	1.71	2.95	4.17	4.74	5.25
May	3.13	3.60	5.11	5.48	5.30
June	3.34	4.49	4.69	3.93	3.50
July	3.08	4.35	3.51	3.24	3.38
August	2.64	3.10	2.95	2.91	3.01
September	1.67	3.69	4.07	3.31	3.55
October	1.65	2.50	3.22	3.47	2.99
November	0.59	1.17	1.87	3.08	3.86
December	0.51	1.12	1.64	2.89	4.09
Annual	20.58	30.58	36.90	42.27	48.52

The average annual runoff varies from less than 0.5 inch in the western plains to 18 inches in central Arkansas. Floods occur more frequently during spring months, but records show that large floods may occur at anytime during the year. The recorded flows at Little Rock have ranged from a low of 850 cfs on 23 August 1934 to a high of 536,000 cfs on 27 May 1943. The average recorded flow at Little Rock for a 50-year period ending 30 September 1977 is 41,080 cfs (29,760,000 acre-feet per year).

B. Development. Federal development of the Arkansas River Basin water resources downstream from Great Bend, Kansas, began with the 1936 Flood Control Act (P.L. 738, 74th Congress). A comprehensive report of possible plans of development of the Arkansas River and tributaries for flood control and other uses was published in 1936 as House Document No. 308, Law No. 525, (79th Congress, 2d Session) as amended by Flood Control Acts of 1948 and 1950, authorized plans for comprehensive development of the Arkansas River and tributaries. The approved plan provides for development of the river for navigation, hydroelectric power, flood control, and allied benefits.

There are currently 24 federally constructed reservoirs on the tributaries and 5 on the main stem. Six reservoirs (Big Hill, Candy, Copan, El Dorado, Optima, and Skiatook) are under construction. In addition to the reservoirs, channel improvements and 17 locks and dams have been constructed to provide navigation from the mouth of the Arkansas River to Catoosa, Oklahoma. Construction began on the Arkansas River Navigation project in 1957. Navigation reached Little Rock in December 1968; Fort Smith in December 1969; and the Port of Catoosa, at the head of navigation, in December 1970. Pertinent data for these projects are shown on plates 2 and 3.

The Grand River Dam Authority has constructed 3 projects in the Lower Grand (Neosho) River Basin for hydroelectric power and flood control. These are Grand Lake (Pensacola), Salina pump-back storage project, and Lake Hudson. In addition to the above mentioned projects, the Soil Conservation Service has constructed numerous detention type structures to control runoff on the small tributary watersheds.

III. REGULATION GOALS

A. General. The approved water control plan for the individual projects in the Arkansas River Basin are contained in the water control manual for each project. The water control plan for the system regulation of the projects in the Arkansas River Basin is contained in the master water control manual for the basin which is presently being revised as described in Section IV. Any deviation or revision to these plans is subject to approval of the Southwestern Division, Reservoir Control Center. The goals to be accomplished by following the water control plans are presented in the following section.

B. Goals for Various Purposes.

a. Fish and Wildlife Enhancement. The Fall River, Elk City, Council Grove, John Redmond, Wister, Blue Mountain, and Nimrod Lakes are regulated for fish and waterfowl enhancement in addition to the other authorized project purposes. This is accomplished through the use of seasonal pool levels. The plans for conservation pool level fluctuations are aimed at producing greater fish and wildlife harvests, and more fishing and hunting benefits.

b. Flood Control. The greatest portion of flood benefits in this basin are from damages prevented to crops and rural structures. About 60 percent of the benefits are obtained from rural areas and 40 percent from urban areas. The reservoirs are regulated according to the criteria prescribed by the plan of regulation for the system to make use of the available storage and downstream channel capacities.

c. Navigation. Arkansas River navigation from Tulsa to the mouth became a reality in December 1970. A navigable depth of nine feet will be maintained. The only storage water to be specifically released for navigation will be from the Oologah project on the Verdigris River.

d. Power Production. The eight Federal hydropower plants in the Arkansas Basin are integrated into a system of plants located in the Arkansas-White-Red River Basins. The power is marketed by the Southwestern Power Administration. Constraints on power generation are designed to minimize loss of energy, meet design capability, and meet the operation requirements for all other project purposes.

e. Recreation. Recreation is not an authorized project purpose in most of the reservoirs; however, its importance is highly recognized. Recreation benefits, though difficult to evaluate, are obviously present. When practical, project operations may be restrained to stabilize pools or limit pool fluctuations. The seven Corps lakes which have recreation as an authorized project purpose are Kaw, Birch, Council Grove, Marion,

John Redmond, Optima, and Robert S. Kerr. There are also two Bureau of Reclamation lakes, Cheney and Meredith, which have recreation as an authorized purpose.

f. Water Supply. Water supply storage in Federal reservoirs is allocated to a specific user. Reallocation of storage in an existing project from another purpose to water supply is possible under the Water Supply Act of 1958. Whenever a request for such a reallocation is received, the Corps of Engineers determines the amount of storage necessary to provide the required yield and the effect on all project purposes. The proposed reallocation is coordinated with other affected agencies.

g. Water Quality. Releases from projects containing water quality storage are made to meet current water quality flow requirements at downstream control points. Releases are also made for emergency conditions that may occur. Water quality improvement also occurs as a by-product of releases made to satisfy other project purposes.

IV. PLAN OF REGULATION

A. General. In the latter part of 1973, a cooperative effort between the Tulsa and Little Rock Districts and the Southwestern Division office was initiated to develop a system water control plan to replace the 1954 Arkansas River Basin Master Regulation Manual. The completion of several new reservoirs, greater demands on hydroelectric power, post flood flow regulation requirements for the navigation system, and the loss of channel capacity in the vicinity of Van Buren, Arkansas, were major factors considered in the development of the basin water control plan. During the development period for the system regulation, an "interim plan of regulation" was used for the period 1974-1976. This plan was described in the 1975 and 1976 reports to the committee. Based on the study results through 1976, an updated plan was adopted for 1977 regulation and described at the 24 March 1977 committee meeting.

B. Studies. Studies were made considering several alternatives such that the best system regulation plan could be selected for the projects in the Arkansas River. The computer model "SUPER" was used to simulate the effects of the overall range of acceptable operational plans for the 35 years of historical flow records. More than 20 operational plans were evaluated to determine their effects on power, flood control, navigation, and recreation and the one producing the best balance between these project purposes was selected.

C. Accomplishment of Adopted Plan. The adopted plan provides for evacuation of water from flood storage at a variable rate which depends on the severity of the flood. The plan allows for a reduction in the release when only the lower portion of the flood pools are utilized. This reduced release rate allows more of the water to be used for the production of power and aids navigation by providing a "taper" to extend the time flows can be held in the 20,000 to 40,000 cfs range. This "taper" in the release at the end of large floods provides additional time for dredging that may be required to restore the channel to design dimensions. The plan also provides for some release from the power pools in order to extend the taper when necessary. The guide curve on plate 4 shows the regulated flow rate at Van Buren which varies according to the time of year and percent of basin storage utilized.

The adopted plan shows that the same frequency of filling of the flood pool as the design anticipated and about a three percent reduction in downstream damages. The pool area damages were about one percent greater under the adopted plan. The effect on power production was to increase the average annual power production by about one percent. The adopted plan is expected to reduce the cost of dredging and benefit navigation by reducing restrictions on shipping due to silting of the channel. The following summary shows six plans considered in the final

evaluation. These plans were ranked from one to six for the various purposes. A rank of one indicates the most benefits to the indicated purpose.

PURPOSE	PLAN					
	A	B	C	D	E	F*
Flood Control	4	6	3	5	2	1
Recreation	2	6	4	5	1	3
Navigation	5	1	3	2	6	4
Hydropower	5	2	4	1	6	3
Total	16	15	14	13	15	11

*Adopted Plan

Description of Plans:

"A" - This plan is based on providing a 40,000 to 20,000 cfs navigation taper and evacuating upstream storage at a rate 150,000 cfs. There is a transition zone from about 7 percent to 20 percent of the system storage necessary to make a reasonable taper from 150,000 cfs to 40,000 cfs.

"B" - This plan is the same as plan "A" except system flood storage would be evacuated at a maximum of 105,000 cfs.

"C" - Provides a 40,000 to 20,000 cfs navigation taper and a variable evacuation rate of upstream storage from 105,000 to 150,000 cfs.

"D" - Provides a 40,000 cfs navigation taper and a variable release of 105,000 to 150,000 cfs evacuation of flood storage. This plan is essentially the one used in 1974 as part of interim plan.

"E" - Provides a variable release of 105,000 to 150,000 cfs and no navigation taper.

"F" - The adopted plan provides a 40,000 to 20,000 cfs navigation taper with a portion of the storage required in the spring coming from the power or conservation storage. The plan also provides a variable operational release of 105,000 to 150,000 cfs.

V. SUMMARY OF 1977 REGULATIONS

A. General. The annual precipitation was below normal at every project in the basin above Fort Smith except Fall River. However, most projects experienced above normal rainfall for two or three months during the year. The annual rainfall at selected index stations ranged from slightly above normal at Dodge City, Kansas, in the northwestern portion of the basin about 120 percent of normal at Chanute, Kansas, in the eastern portion of the basin to only 76 percent of normal at Fort Smith, Arkansas. The following stations are shown as an index for the basin:

	Precipitation - Inches		Departure
	1977	Normal	From Normal
Dodge City, KS	22.11	20.58	- 1.53
Wichita, KS	35.76	30.58	- 5.18
Chanute, KS	48.84	39.66	- 9.18
Tulsa, OK	41.46	36.90	- 4.56
Fort Smith, AR	32.29	42.27	- 9.98
Little Rock, AR	45.08	48.52	- 3.44

The year began with the flows in the Arkansas River below normal and lake levels at conservation pool or below. At the beginning of the year the Southwestern Power Administration (SWPA) did not have sufficient funds to purchase supplemental electrical energy to meet the high demands. This resulted in a heavy demand on the hydroelectric power projects and the projects were drawn down well below top of power pool. New period of record minimum pool elevations of 712.99 at Keystone Lake and 575.06 at Eufaula Lake was set in January. The SWPA received emergency appropriations from Congress late in January for purchase of supplemental energy. This allowed a reduction in the heavy hydropower usage and the rate of drawdown in the power pools were reduced.

The main runoff producing storms occurred over the basin in March, May, June, and November. The lake levels were low when the March storm occurred and no rise into the flood pool was experienced except at Fort Gibson. During the May, June, and November storms, flood storage was utilized in most of the lakes.

Impoundment was started at Kaw in April 1976, however, the pool had to be held below top of conservation through July 1976 to complete work in the lake area. During the last half of 1976 there was insufficient runoff to fill the pool. The conservation pool was filled during the May 1977 storm. Birch Lake was operated as a detention basin until 18 March when the gates were closed for impoundment. The lake received little inflow until above normal rainfall produced substantial inflows in May, August, and September. The pool level increased from an

elevation of 711.0 in March to 745.0 in September (top of conservation pool is elevation 750.5). Optima Lake is anticipated to make final closure in 1978.

The total runoff at the Van Buren gage for 1977 was 15.1 million acre-feet as compared to a normal 23 million acre-feet for the 50-year period through 1977. A tabulation of the 1977 maximum and minimum pool elevations for the lakes in the basin is shown on plate 2. The record annual and monthly flows for the Arkansas River at Dam No. 13, near Van Buren, Arkansas, are shown on plates 5 and 6. A graph of the outflow from Lock and Dam No. 13 is shown on plate 7. Graphs of pool levels are shown on plates 8 through 15 for Kaw, Keystone, Fall River, Elk City, Oologah, Council Grove, John Redmond, Pensacola, Fort Gibson, Tenkiller Ferry, Eufaula, Wister, Blue Mountain, and Nimrod Lakes.

B. Fish and Waterfowl. The seasonal guide curves for Council Grove, Elk City, John Redmond, Toronto, Fall River, and Marion Reservoirs were modified at the request of the Kansas State Water Resources Board to improve fishery and wildlife benefits. Minor deviations from the seasonal guide curves which were due to special operations are discussed in the special operations section of this report.

Blue Mountain Lake was lowered 10 feet to elevation 374 beginning 6 June 1977 in cooperation with the Arkansas Game and Fish Commission as an aid in the control of rough fish, the improvement of game fishery, and water clarity. The exposed lakebed was seeded with a Sorghum-Sudan Grass Hybrid. A fish renovation project carried out in late September eliminated approximately 95 percent of the total fish population by weight. Restocking began in late October and will be completed in the spring of 1978. Refilling of the lake began 1 November 1977, but it was still down 7.5 feet on 1 January 1978.

C. Flood Control. During the fiscal year ending 30 September 1977, the 26 Corps of Engineers and Section 7, flood control reservoirs prevented $24,624,000 in flood damages in the Arkansas River Basin. The flood damages prevented during the past 14 fiscal years are shown on plate 16.

a. Above Fort Smith.

(1) As a result of below normal rainfall in the latter part of 1976 and the heavy hydropower demands from November 1976 through January 1977, the power projects were below the top of power pools at the beginning of 1977. Flows at Van Buren, Arkansas, ranged from near zero to 15,000 cfs during January, February, and the first 3 weeks in March.

(2) Moderate runoff in late March raised the pool levels in the power projects, but with the large drawdowns that existed at the time, no flood storage was utilized except at Fort Gibson. The peak flow past Van Buren, Arkansas, was about 125,000 cfs with approximately one-half of that originating from the area below R. S. Kerr. During the latter half of May intermittent moderate rainfall produced sufficient runoff to use the flood pools in many of the lakes. Most of the inflow into the power projects occurred at rates which allowed it to be discharged through the hydropower units. The only spill required at the projects due to this storm was at Keystone.

(3) Heavy rainfall during the period 16-27 June in Southeastern Kansas, Southwestern Missouri, and Northeastern Oklahoma, produced sufficient runoff in the Verdigris and Grand (Neosho) River Basins to fill the power pools of the power projects and cause minor flood operations at the non-power projects. Projects in the Verdigris River Basin utilized 30 to 76 percent of their flood control pools while the Grand (Neosho) Basin utilized 25 to 41 percent. The peak flow past Van Buren, Arkansas, during this period was 76,000 cfs. Flood control releases at Pensacola were started on 21 June and ended on 10 July with full power being made until 25 July. Keystone Lake pool was at or slightly above the top of the power pool from 21 May to 7 October with essentially all the outflow made through the hydropower turbines. The Arkansas River Basin System Regulation Plan for 1977 indicated a regulated flow of 105,000 cfs at Van Buren. However, due to the extremely short period of time that the 105,000 cfs would be required, the Tulsa District recommended a deviation from the 1977 plan of regulation. This deviation resulted in eliminating damages to navigation depths. Evacuation of the floodwaters was accomplished by maintaining a flow of near 75,000 cfs at Van Buren from 26 June to 9 July and then slowly decreasing the flows to near 20,000 cfs on 20 July, and maintaining a flow near 20,000 cfs until 30 July. The following tabulation shows the date and maximum percent full at the peak pool elevation for the lake affected by the flood.

June 1977 Storm

Lake	Maximum Pool Elevation	Maximum Flood Storage Utilized %	Date 1977
Toronto	915.43	30	25 June
Fall River	972.09	46	27 June
Elk City	820.12	76	26 June
Oologah	647.16	31	2 July
Hulah	748.27	33	29 June
Council Grove	1284.62	66	26 June
Marion	1352.84	25	26 June
John Redmond	1055.09	44	26 June
Pensacola	747.89	25	27 June
Lake Hudson	624.94	29	28 June
Fort Gibson	561.68	18	27 June
Kaw	1022.96	29	28 June
Keystone	728.62	13	5 July

The experienced and natural stages at key stations are shown in the following tabulation.

June 1977 Storm

Gage	Date	Flood Stage	Experienced Stage	Natural Stage(1)	Flooding Prevented
Kaw	23 June	944.5	*	951.8	7.3
Fredonia, KS	22 June	17.0	*	35.0	8.0
Elk City, KS	22 June	20.0	*	32.1	12.1
Independence, KS	24 June	30.0	38.3	46.0	7.7
Oologah, OK	23 June	39.0	*	65.1	26.1
Bartlesville, OK	25 June	13.0	*	18.3	5.3
Ramona, OK	27 June	26.0	*	28.8	2.8
Inola, OK	25 June	42.0	*	47.9	5.9
Council Grove, KS	24 June	14.3	*	24.7	10.4
Burlington, KS	21 June	23.0	*	28.2	5.2
Muskogee, OK	26 June	26.0	*	29.0	3.0
Sallisaw, OK	26 June	24.0	*	27.5	3.5
Van Buren, AR	25 June	22.0	*	28.7	6.7

*Below bankfull

(1) Natural stage would have occurred with no Corps of Engineers lakes

(4) Rainfall occurring during early November on the Verdigris and Grand (Neosho) Basins in Missouri and Kansas, again caused the pool levels of the lakes in the area to rise into the flood control pool requiring small flood releases. Flood releases were initiated at Oologah and Hulah Lakes on 3 November and ended on 28 and 23 November, respectively. Flood releases at Pensacola were started on 9 November and ended on 15 November with full power generated until 2 December. The flood gates were opened at Fort Gibson on 2 November and closed on 2 December. The November flood releases on the Verdigris and Grand (Neosho) River system produced a peak flow of 52,000 cfs at Van Buren on 12 November. The evacuation of the flood water was accomplished by maintaining flows at Van Buren mostly in the 30,000 to 45,000 cfs range from 4 November to 27 November and then reducing the flows to power generation only on 3 December. The following tabulation shows the date and maximum percent full at the peak pool elevation for the lakes affected by the November storm.

November Storm

Lake	Maximum Pool Elevation	Maximum Flood Storage Utilized %	Date 1977
Toronto	913.12	25	9 November
Fall River	956.96	12	10 November
Elk City	801.30	11	4 November
Oologah	645.32	21	11 November
Hulah	741.43	15	4 November
John Redmond	1042.90	10	10 November
Pensacola	746.57	13	13 November
Hudson	620.75	6	10 November
Fort Gibson	555.87	4	16 November

The experienced and natural stages at key stations are shown in the following tabulation:

November 1977

Gage	Date	Flood Stage	Experienced Stage	Natural Stage(1)	Flooding Prevented
Fredonia, KS	9 Nov	17.0	*	20.0	3.0
Elk City, KS	2 Nov	20.0	*	23.1	3.1
Coyville, KS	8 Nov	28.0	*	36.1	8.1
Independence, KS	2 Nov	30.0	*	32.0	2.0
Oologah, OK	4 Nov	39.0	*	40.0	1.0
Bartlesville, OK	3 Nov	13.0	*	15.6	2.6
Ramona, OK	3 Nov	26.0	*	28.6	2.6
Burlington, KS	9 Nov	23.0	*	25.8	3.8
Van Buren, AR	14 Nov	22.0	*	23.4	1.4

*Below bankfull
(1) Natural stage would have occurred with no Corps of Engineers lakes.

b. Below Fort Smith. Two major rises occurred in the Arkansas River Basin below Fort Smith during the year, March and May. They are shown on plate 7. Rainfall during the period 27-28 March was 2.5 inches at Little Rock and 4.88 inches at Van Buren. Rainfall from 20-23 May was 1.65 inches at Van Buren and 9 inches at Little Rock. The rises on the Arkansas River were supplemented by rain in Oklahoma. The experienced and natural stages at key stations are shown in the following tabulation:

STAGES AT KEY STATIONS

Gage	(NWS) Flood Stage	Experienced Stage	Natural Stage (1)	Approximate Reduction in Feet	Date
Van Buren	22 ft	21.2 ft	30.5 ft	9.3 ft	28 Mar
	22 ft	21.2	25.4	4.2	26 May
Ozark	357	356.6	362.8	6.2	28 Mar
Dardanelle	32	32.1	36.0	3.9	29 Mar
Morrilton	30	31.6	34.4	28.8	29 Mar
Little Rock	23	19.3	23.2	3.9	30 Mar
Pine Bluff	47	38.3	42.0	3.7	30 Mar

(1) Natural stage would have occurred with no Corps of Engineers' lakes

(1) On the Fourche LaFave River Basin during March 1977, the Houston gage crested at 28.9 feet which was 4.9 feet above the flood stage at 24.0 feet. In the month of April, Nimrod Lake utilized 45 percent of its available flood control storage and was responsible for reducing the stage at Houston about 7.2 feet.

(2) Flooding was also experienced in the Petit Jean River Basin during the same period. Danville crested at 24.5 feet on 28 March 1977 which is 4.5 feet above flood stage. On 1 April 1977, Blue Mountain Lake utilized 30 percent of its flood control storage and was responsible for reducing the stage at Danville about 2.5 feet.

D. Navigation. Preliminary estimates indicate that about 9.1 million tons of commerce moved on the McClellan-Kerr Arkansas River Navigation System in 1977. This represents an increase of 40 percent above the 1976 level. Commodities consisted of bauxite, iron and steel, chemicals and chemical fertilizers, petroleum products, coal, sand and gravel, crushed stone, soybeans, wheat and other grains, and miscellaneous commodities. Outbound movements increased 64 percent. Inbound movements also increased 64 percent, and internal movements increased 18 percent. Commodities showing the greatest increase in movement from 1976 were coal, iron and steel, petroleum products, and grains. The increase for these commodities were 157, 112, 53, and 42 percent, respectively. A comparison of the tonnage for 1976 and 1977 is as follows:

	1976* (Tons)	1977** (Tons)
Inbound	1,734,503	2,800,000
Outbound	1,425,791	2,300,000
Internal	2,824,018	3,500,000
Through	554,122	500,000
TOTAL	6,538,434	9,100,000

*Waterborne Commerce Statistics Center
**Estimated

Graphs of the traffic on the system are shown on plates 17 and 18.

a. Above Fort Smith. Preliminary estimates indicate that the tonnage on the Tulsa District portion of the navigation system in 1977 totaled 2,749,157 tons, up 55 percent from that moved in 1976. Commodities showing the greatest increases in movement from 1976 were coal and chemical fertilizer, both up over 100 percent. Other commodities showing significant increases were iron and steel, chemicals, grain, and petroleum products. During 1977, maintenance dredging to maintain navigable channel depths on the Tulsa District portion of the navigation system amounted to approximately 142,500 cubic yards in pools 17 and 18 and 259,500 cubic yards in pool 15.

b. Below Fort Smith.

(1) During 1977, the Arkansas River flows were generally excellent for navigation. The flows at Dam No. 2 were above 150,000 cfs for 2 days, between 75,000 cfs and 150,000 cfs for 18 days and below 75,000 cfs the remaining time. Low Mississippi River stages and low flows on the White River affected the lower 10 miles of the McClellan-Kerr system by decreasing navigation depths and widths below the authorized dimensions on the White River. The White River entrance channel was blocked from 5 February until 16 February and restricted to light draft vessels during daylight hours until 19 February. The White River was also restricted from 14-29 June when traffic was permitted during daylight hours only with a maximum draft of 8.5 feet. The White River entrance channel was closed from 5 August until 8 August while a dredge removed two shoals. Traffic was restricted to daylight hours only from 8 August until 15 August.

(2) Maintenance dredging to maintain navigable depths amounted to approximately 1.7 million cubic yards in 1977. This was a decrease of about 0.2 million cubic yards from the 1976 dredging requirements. Several pools were held above the normal elevation to maintain navigation while the channel was being dredged. Navigation-related accidents during the year were relatively minor. Minor damage occurred at Murray Lock when a commercial barge struck a miter gate.

E. Power Production. The dry conditions which existed during the last five months of 1976, contributed to the pools at the power projects being below normal at the beginning of the year. Also, the pools were being drawn down rapidly due to the high demand on hydroelectric power. Due to a shortage of funds, the Southwestern Power Administration (SWPA) was unable to purchase supplemental power from other sources. During January, Keystone and Eufaula Lakes set new minimum pool elevations of 712.99 and 575.0, respectively. When emergency funds were received by SWPA in January, the heavy hydropower demands were eased. With reduced power demands and improved flow conditions, most of the power pools refilled by the end of May. At the end of the year, all the power storage projects were near their rule curve with the exception of Eufaula which was one foot low. An explanation of the rule curves is included as Exhibit 1 in this report.

The hydropower generation for five calendar years, 1973 through 1977, is shown in the following tabulation:

POWER GENERATION (gwh)
ARKANSAS RIVER BASIN PROJECTS

	ACTUAL FOR CALENDAR YEARS					5-Year Average	
	1973	1974	1975	1976	1977	1972-1976	1973-1977
Keystone	439	454	355	151	205	300	321
Fort Gibson	367	343	265	161	202	265	268
Webbers Falls	68*	373	318	173	214	-	-
Tenkiller	231	207	170	101	36	162	149
Eufaula	473	348	399	162	79	306	292
R. S. Kerr	784	849	704	411	469	624	643
Ozark	28*	353	469	186	308	-	-
Dardanelle	766	879	735	509	612	671	760
TOTAL	-	3806	3415	1854	2125	-	-

*Partial year

F. Recreation. The lakes and navigation pools in the Arkansas River Basin provide vast expanses of water and shoreline for use in meeting the growing demands for water-associated recreation. The natural beauty of the area is considered in planning public use areas at these lakes. Recreational development plans are coordinated with state and Federal park, fish and wildlife, and archaeological agencies.

The experimental seasonal pool at Wister Lake was continued in 1977, however, due to the lack of sufficient rainfall the pool never reached the desired level, elevation 478.0. Elevation 474.0 was the highest elevation reached during the summer recreational season. The effect this had on seasonal attendance has not been determined.

In the Little Rock District there are 76 parks planned for development in the McClellan-Kerr Navigation System. Fifty-seven of these parks have been developed under the initial recreation program. While most of these parks are now available for public use, all will be completed in Fiscal Year 1981. These parks are being managed by the Corps of Engineers. Nine others have been jointly developed by the Corps and non-Federal interest and two were developed by non-Federal interests. Eight more parks are reserved for future development, two of which are to be developed by the State of Arkansas.

During 1976, the commercial fish catch was 2.2 million pounds with a value of $0.8 million. There were 87 licensed full-time commercial fishermen and 867 casual commercial fishermen operating on the river.

The overall lake attendance for 1977 was approximately 12 percent greater than for 1976. Attendance records were begun in 1977 for two new projects, Birch and Optima. Lake attendance for the period 1973 through 1977 is summarized in the following tabulation:

ARKANSAS RIVER BASIN
LAKE ATTENDANCE
(1000's of People)

Lake	Calendar Year 1973	1974	1975	1976	1977
Cheney	954	1,007	575	601	585
Great Salt Plains	960	795	1,136	914	793
Keystone	3,121	3,646	3,022	4,129	3,873
Heyburn	717	593	783	1,124	792
Toronto	555	509	608	634	578
Fall River	331	371	434	520	493
Elk City	424	488	552	686	489
Oologah	1,341	1,232	1,421	1,781	1,841
Hulah	500	588	684	1,125	989
Birch	-	-	-	-	79
Council Grove	1,018	1,019	879	1,060	917
Marion	814	1,163	794	928	806
John Redmond	630	444	608	528	623
Grand Lake (Pensacola)(1)	NA	137	509	1,257	1,259
Lake Hudson (Markham Ferry)(1)	NA	30	35	41	44
Fort Gibson	3,971	3,998	4,110	3,570	6,944
Tenkiller Ferry	4,016	4,962	5,226	5,668	6,514
Lake Meredith (Sanford)	1,683	1,732	1,709	1,826	1,631
Lake Thunderbird (Norman)(1)	2,500	1,751	1,356	1,730	1,998
Optima	-	-	-	-	6
Fort Supply	355	431	550	948	721
Canton	1,179	1,368	2,473	2,728	2,843
Eufaula	4,524	4,575	4,694	5,387	6,319
Wister	1,016	983	1,086	1,075	1,024
Blue Mountain	265	262	244	223	232
Nimrod	514	494	493	495	440

(1) Attendance shown was furnished by Oklahoma Tourism and Recreation Department. This is for State parks only.

ARKANSAS RIVER BASIN
LAKE ATTENDANCE (CONTI-)
(1000's of People)

Navigation Pools	Calendar Year				
	1973	1974	1975	1976	1977
Newt Graham Lock & Dam	56	115	301	500	726
Chouteau	78	225	294	360	488
Webbers Falls	203	249	542	583	1,142
Robert S. Kerr	681	673	848	1,055	1,195
W. D. Mayo	124	89	144	282	228
Lock and Dam No. 13	184	199	583	599	675
Ozark (Jeta Taylor) Lock and Dam	491	581	611	860	953
Dardanelle Lock and Dam	2,128	2,326	2,202	2,778	3,259
Lock and Dam No. 9	151	137	159	354	345
Toad Suck Ferry Lock and Dam	71	134	248	530	541
Murray	387	402	541	811	819
David D. Terry	639	398	635	824	1,570
Lock and Dam No. 5	343	259	288	255	176
Lock and Dam No. 4	689	594	531	615	197
Lock and Dam No. 3	191	186	226	231	231
Lock and Dam No. 2	547	568	513	639	488
Norrell Lock and Dam	54	75	68	68	36

NA Not available.

G. Water Supply. Water supply storage space is allocated in 16 of the Corps of Engineers lakes in the basin. Contracts for all or portions of this space are in effect at all of these lakes except Kaw and Birch. These are new lakes and the water supply contracts had not been approved, as of the end of 1977. During 1977 a total of 53,914 acre-feet of water was supplied from the storage space in these lakes. This amount is about 28 percent less than the amount used in 1976. The following tabulation shows the lakes which have water supply storage.

WATER SUPPLY

Reservoir	Water Supply			Water Supplied (ac-ft)	
	Allocation (ac-ft)	Contracts (ac-ft)	Number of Contracts	1976	1977
Kaw	171,200	None	None	None	None
Keystone	20,000	18,490	4	115	171
Heyburn	1,900	900	2	643	669
Toronto	400	265	1	78	80
Elk City	24,300	24,300	1	None	None
Oologah	342,600	44,200	6	9,024	7,859
Hulah	19,900	17,900	3	8,062	6,739
Birch	7,600	None	None	None	None
Council Grove	24,400	24,400	1	None	None
Marion	38,300	38,300	1	None	None
John Redmond	34,900	34,900	1	None	None
Fort Gibson	None	None	None	10,458(1)	10,971(1)
Tenkiller Ferry	25,400	18,356	18	2,216	3,584
Fort Supply	400	400	1	249	208
Canton	107,000(2)	90,000(3)	2	53,101	36,133
Eufaula	56,000	2,295	17	1,104	1,247
Wister	9,600	6,400	2	442	424

NOTE: 1. Water supplied to satisfy pre-project water rights.
2. Water Supply - 38,000 acre-feet; Irrigation - 69,000 acre-feet.
3. Water Supply - 38,000 acre-feet; Irrigation - 52,000 acre-feet (currently being used for W. S. purposes pending development of irrigation features).

H. Water Quality. A Corps of Engineers dredged material sampling program along the Arkansas River is continuing to determine if dredging areas were polluted according to Environmental Protection Agency criteria. Thus far, all area samples have fallen within safe limits established by EPA and no dredging operations would be prohibited by these criteria. The Little Rock District contracted with the University of Arkansas to conduct a study of the beneficial and adverse effects of dredging along the Arkansas River below Fort Smith. The report indicated no unusual effects resulting from these activities.

a. Above Fort Smith.

(1) The Tulsa District is currently collecting water quality data at regular intervals from Eufaula, Keystone, Oologah, Tenkiller, Toronto, and Wister Lakes. In addition to the above mentioned lakes, water quality data was collected by the USGS at various locations in the McClellan-Kerr Arkansas River Navigation System during the 1977 calendar year.

(2) Studies of salt control measures for the Arkansas River Basin proceeded through the formulation stage with numerous water quality samples being taken in and near the source areas. Phase I General Design Memorandums are now being prepared.

(3) Releases from Tenkiller Lake were continued on the same regular schedule as in past years for the purpose of trout fishing below the dam. Also, special releases were made at Heyburn to prevent fish kills and at Toronto and Fall River for pollution abatement.

b. Below Fort Smith.

(1) Water quality in the lower reaches of the Arkansas River has improved since the completion of the navigation project in 1969. The controlled releases have had a smoothing effect on the river, maintaining a navigable channel and reducing heavy silt and sedimentation loads. The principle water quality problems continue to be turbidity, excessive chlorides, and bacteria. While the total salt load has not diminished greatly, the extremes of concentration have been leveled out due to the flow regulation features of the project.

(2) Coliform bacteria counts in the Arkansas River still remain at higher levels than considered safe for swimming by the Arkansas State Board of Health. Indications are that the coliform levels along the entire Arkansas portion of the river are generally improving, but the waters will not consistently meet with health standards until additional upgrading of municipal sewage treatment plants and chlorination of effluents are completed. A 50-mile stretch of the river between Little Rock and Russellville has continued to meet the total and fecal coliform limits for contact recreation sports and has been designated as a Class A stream by the Arkansas Department of Pollution Control and Ecology. The cities of Fort Smith and North Little Rock are in upgrading schedules, but new facilities will probably not be completed until June 1978 for Fort Smith and January 1979 for North Little Rock. As additional improvements are made to municipal sewage treatment systems, bacteriological quality will improve and should result in consistent good quality water along the waterway.

(3) During periods of low or zero natural flow in the Petit Jean River, a release of not less than five cubic feet per second is made from Blue Mountain to meet the domestic water requirements for the town of Danville, Arkansas, which pumps water from a pool in the river channel. This release also supplies water to the natural pools in the river and aids in maintaining fish life.

(4) Water quality monitoring along the Arkansas River and many of its tributaries is done by the US Geological Survey (USGS) and the Arkansas Department of Pollution Control and Ecology on a regular basis. Water quality data concerning various reaches of the river are available from those agencies.

I. Sedimentation. Maintenance dredging in the McClellan-Kerr Arkansas River Navigation System Channel during 1977 was 1.9 million cubic yards. This was about 0.5 million cubic yards less than the dredging required in 1976.

Model studies of navigation miles 313 to 323, above and below W. D. Mayo Lock and Dam, were completed in 1977. Construction of structures, planned as a result of the model studies have also been completed. The effect of those structures on sedimentation in this area are as yet unknown; however, no dredging in this reach was required in 1977.

Construction of dikes in Robert S. Kerr Reservoir in the vicinity of navigation mile 358.5 have been completed. These dikes should prevent Canadian River sediment from entering the navigation channel.

Sediment surveys of Canton, Eufaula, Keystone, Oologah, and Toronto Lakes were conducted during the year and data from these surveys are being studied. Reports on these surveys are scheduled for 1979. Due to heavy workloads the previously scheduled reports on W. D. Mayo, Robert S. Kerr, and Webbers Falls Locks and Dams have been rescheduled for 1978.

Engineer Form 1787's on the 1975 sediment survey of Hulah Lake were submitted and approved. The detailed report on the 1969 sediment survey of Eufaula Lake was completed and approved. Detailed reports on the 1969 sediment surveys of Fort Supply Lake are about 90 percent complete and are scheduled for submittal in early 1978. Detailed sediment studies on the Area I, Chloride Control Studies, Fry Creek, and Haikey Creek projects were conducted during the year.

Computerization of all data on suspended sediment sampling stations is in progress. When completed, this program will provide updated data on sediment concentrations, flow duration, and sediment loads at all stations within the Tulsa District.

The Motorola Mini-Ranger System for hydrographic surveys of lake beds was modified and a Track Indicator added. This equipment was tested on five district lakes during 1977 and is now ready for use throughout the Southwestern Division

Analysis and adaptability studies of the computer program, HEC-6, "Scour and Deposition in Rivers and Reservoirs," are being made for application to Tulsa District sediment studies.

J. Special Operations. Several short-term special operations were required during the year. These are summarized as follows:

(1) Special drawdowns were made at Kaw to reduce erosion at the toe of the riprap on the face of the embankment; at Elk City to aid Kansas Fish and Wildlife personnel planting millet in the lake area; at Marion and John Redmond to facilitate repair to the riprap along the face of the dam; and at W. D. Mayo Lock and Dam to facilitate construction of wood pile mooring facilities upstream of the dam.

(2) Discharges were reduced at Toronto to facilitate surveying the degradation ranges; Fall River to facilitate stilling basin inspection and to aid wheat farmers using low water crossings; at Elk City to aid in recovery of a pickup truck in the river; at Oologah for stilling basin repairs, to allow a rural water district to replace a pump in the river, and to aid in the recovery of a drowning victim; at Hulah to allow the city of Bartlesville to remove trash from a water supply pipe located in the stilling basin, and to aid in the recovery of a drowning victim; at Webbers Falls Lock and Dam the power discharge was shut off to search for equipment lost in the river by the State Highway Department, and when one of the generators burned out in the Webbers Falls Power Plant; at Keystone to aid in the search for drowning victims; and at Heyburn and Wister for stilling basin inspections.

(3) Special releases were made at Heyburn to prevent fish kills, and at Toronto and Fall River for removal of trash from water supply intakes.

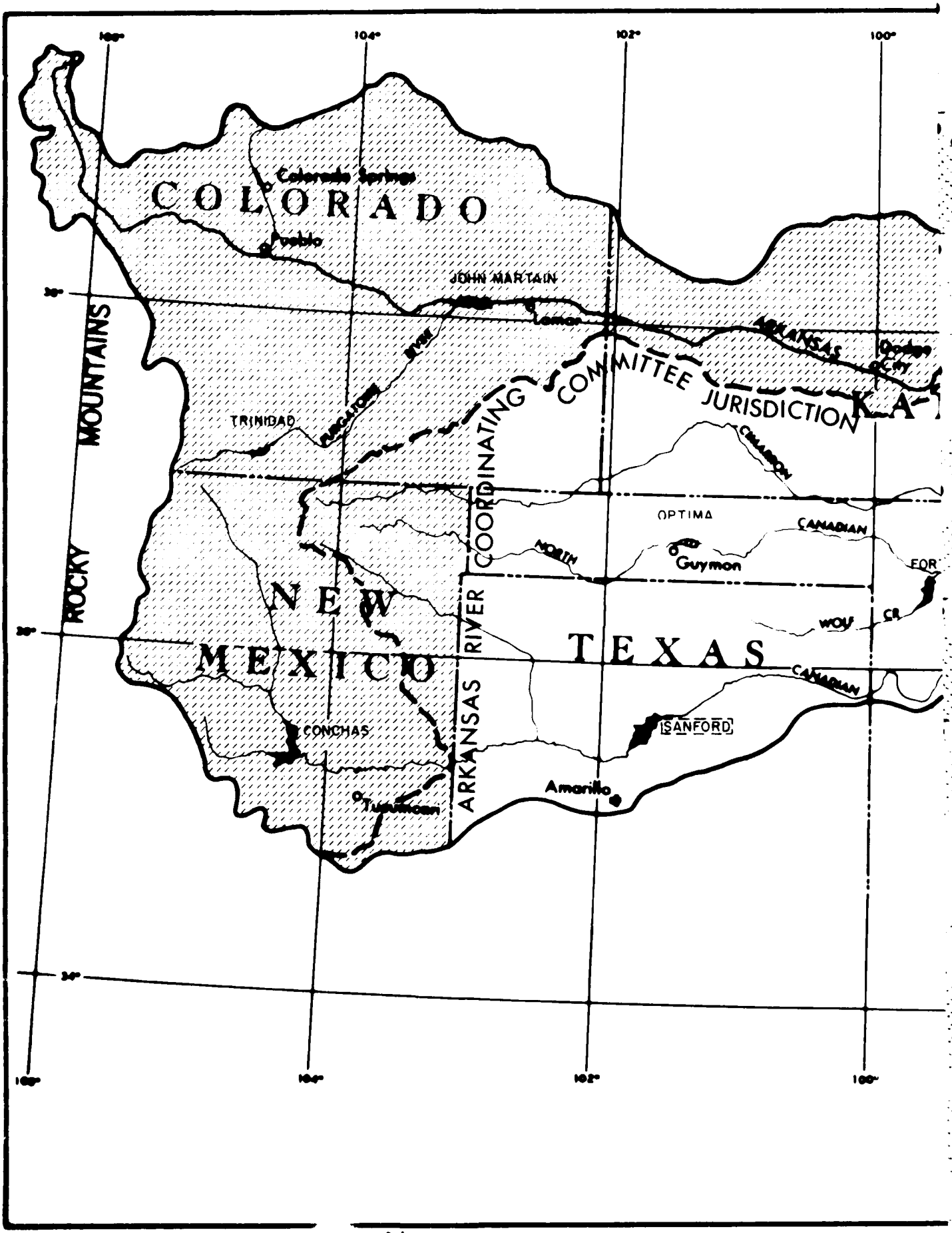
(4) Newt Graham Lock and Dam was operated approximately one-half foot high from January to March to provide adequate depth in the port area.

(5) The seasonal guide curve at Wister Lake was continued in 1977 again on a trial basis, however, due to the lack of sufficient rainfall the desired pool level was never reached.

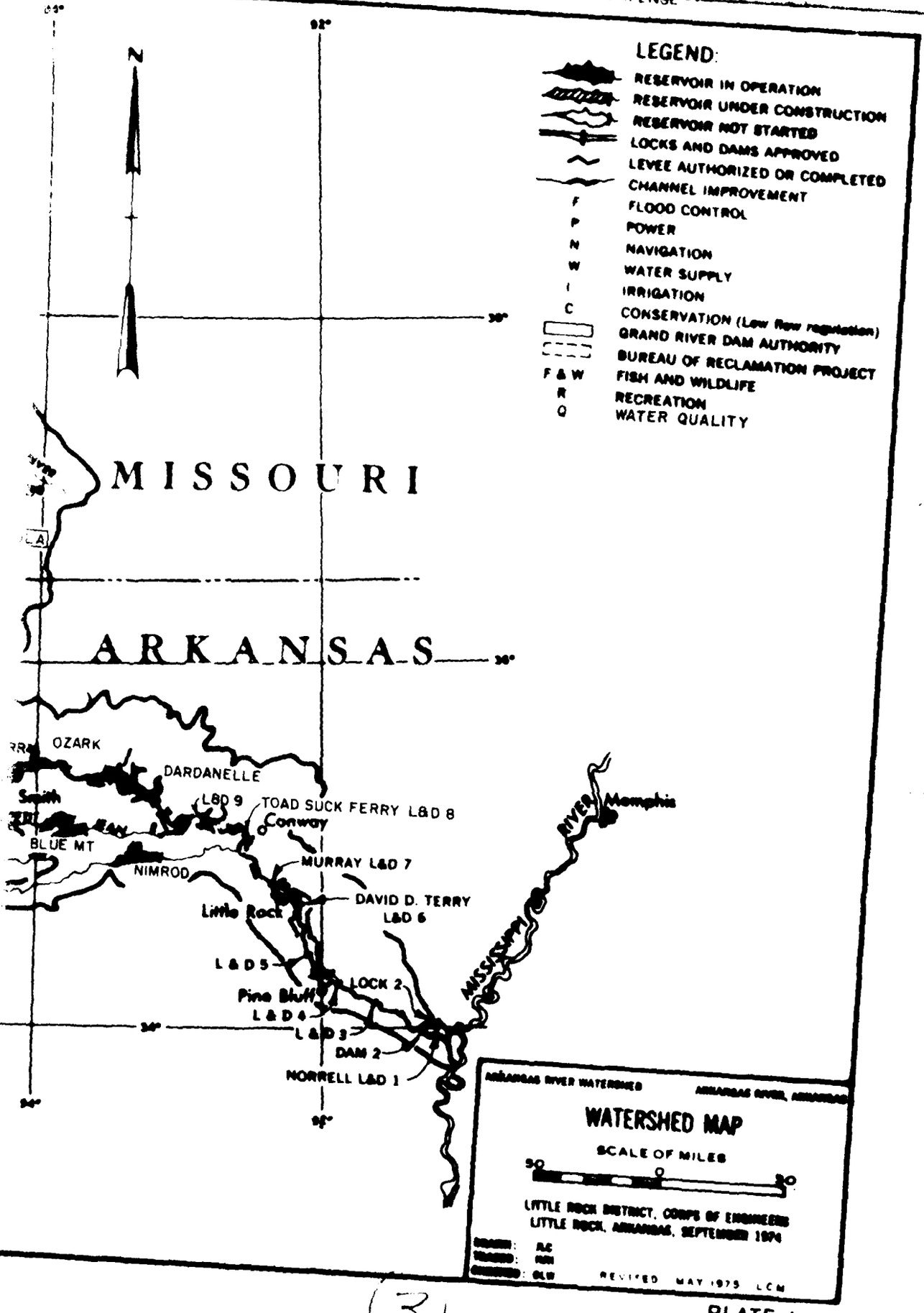
VI. Plans for 1978

A plan of regulation for the Arkansas River Reservoir System has been developed based on System Studies accomplished during the past two years. The plan is similar to the operation used during the past two or three years. The plan includes individual project guide curves, a Van Buren guide curve, and system balancing of flood storage. The plan takes into consideration all beneficial uses of the projects and reflects a balancing of flood control and navigation requirements with emphasis on post-flood recovery of the navigation requirements.

The adopted plan will be presented in the Arkansas River Lake Regulation Master Manual which is currently in the final stages of preparation.



2



(3)

PLATE 1

ANNUAL MAXIMUM AND MINIMUM POOL ELEVATIONS
ARKANSAS RIVER BASIN PROJECTS BELOW CREAT BEND KANSAS

PROJECT	STREAM	YEAR IN OPERATION	CONSERVATION POOL ELEV	CONSERVATION STORAGE AC-FT	FLOOD CONTROL POOL ELEV	FLOOD CONTROL STORAGE AC-FT	1977 POOL ELEVATIONS MAXIMUM ELEV	MAXIMUM DATE	MINIMUM ELEV	MINIMUM DATE
Cheney 1/	N. F. Ninnescah	1964	1421.6	151,800	1429.0	80,860	1425.0	3 Sep	1420.2	3 Jan
Great Salt Plains	Salt Fork Ark	1941	1125.0	0	1138.5	242,700	1127.3	26 May	1124.4	1 Jan
Kaw	Arkansas R.	1976	1010.0	343,500	1044.5	919,400	1023.0	27 Jun	995.1	26 Mar
Keystone	Arkansas R.	1964	723.0	351,000	754.0	1,216,000	733.2	31 May	713.0	14 Jan
Heyburn	Polecat Cr.	1950	761.5	4,400	784.0	49,100	764.4	21 May	759.9	27 Dec
Toronto	Verdigris R.	1960	901.5	10,700	931.0	172,000	915.4	26 Jun	899.7	13 Apr
Fall River	Fall R.	1949	948.5	15,700	987.5	235,100	972.1	27 Jun	944.4	13 Apr
Elk City	Elk R.	1966	792.0	33,500	825.0	256,400	820.1	27 Jun	791.8	7 Sep
Oologah	Verdigris R.	1963	638.0	544,100	661.0	965,600	647.2	2 Jul	636.0	1 Feb
Hulah	Caney R.	1950	733.0	33,400	765.0	257,800	748.6	1 Jul	728.7	14 Apr
Council Grove	Neosho R.	1964	1270.0	37,800	1289.0	76,000	1284.6	26 Jun	1269.9	27 Mar
Marion	Cottonwood R.	1968	1350.5	85,860	1358.5	59,900	1353.4	3 Jul	1347.7	31 Aug
John Redmond	Neosho R.	1963	1036.0	54,000	1068.0	588,100	1055.1	27 Jun	1033.6	22 Aug
Pensacola 1/	Neosho R.	1940	745.0	586,000	755.0	525,000	747.9	25 Jun	733.0	19 Jun
Lake Hudson 1/	Neosho R.	1964	619.0	0	636.0	244,000	624.9	28 Jun	617.8	5 Jun
Fort Gibson	Neosho R.	1952	554.0	53,900	582.0	919,200	561.7	28 Jun	551.8	19 Jan
Webbers Falls	Arkansas R.	1970	490.0	30,000	-	0	490.6	16 May	487.3	29 Oct
Tenkiller Ferry	Illinois R.	1951	634.0	358,900	667.0	589,400	630.6	19 Dec	611.8	20 Jan
Conchas	Canadian R.	1939	4201.0	273,000	4218.0	198,300	4171.0	4 Sep	4158.1	26 Jul
Sanford 1/	Canadian R.	1965	2941.3	866,300	2965.0	462,100	2902.9	1 Jan	2895.7	8 Aug
Norman 1.	Little Rock (Ark)	1965	1039.0	105,900	1049.4	76,600	1037.8	28 May	1034.2	31 Dec
Optima	N. Canadian R.	UC	2763.5	117,650	2779.0	100,500	2722.0	28 May	2706.3	1 Jan
Fort Supply	Wolf Cr.	1941	2004.0	400	2028.0	87,200	2008.0	22 May	2001.2	1 Jan
Canton	N. Canadian R.	1948	1615.2	97,700	1638.0	267,600	1613.3	17 Sep	1604.7	5 Jan
Eufaula	Canadian R.	1964	585.0	1,481,000	597.0	1,470,000	586.2	29 May	575.1	20 Jan
Robert S. Kerr	Arkansas R.	1970	460.0	79,500	-	0	460.4	27 Mar	458.2	30 Sep
Wister	Poteau R.	1949	471.6	30,000	502.5	400,000	491.0	31 Mar	471.0	25 Jun
Ozark	Arkansas R.	1969	372.0	19,400	-	0	372.8	29 Jul	370.0	8 Sep
Dardanelle	Arkansas R.	1964	338.0	65,000	-	0	338.4	23 May	336.0	11 Sep
Blue Mountain	Petit Jean	1947	384.0	0	419.0	233,000	400.3	31 Mar	373.8	19 Oct
Nimrod	Fourche La Fave R.	1942	342.0	0	373.0	307,000	361.6	1 Apr	341.7	30 Oct

1/ Non-Corps project under Sec 7 of 1944 F/C Act

PLATE 2

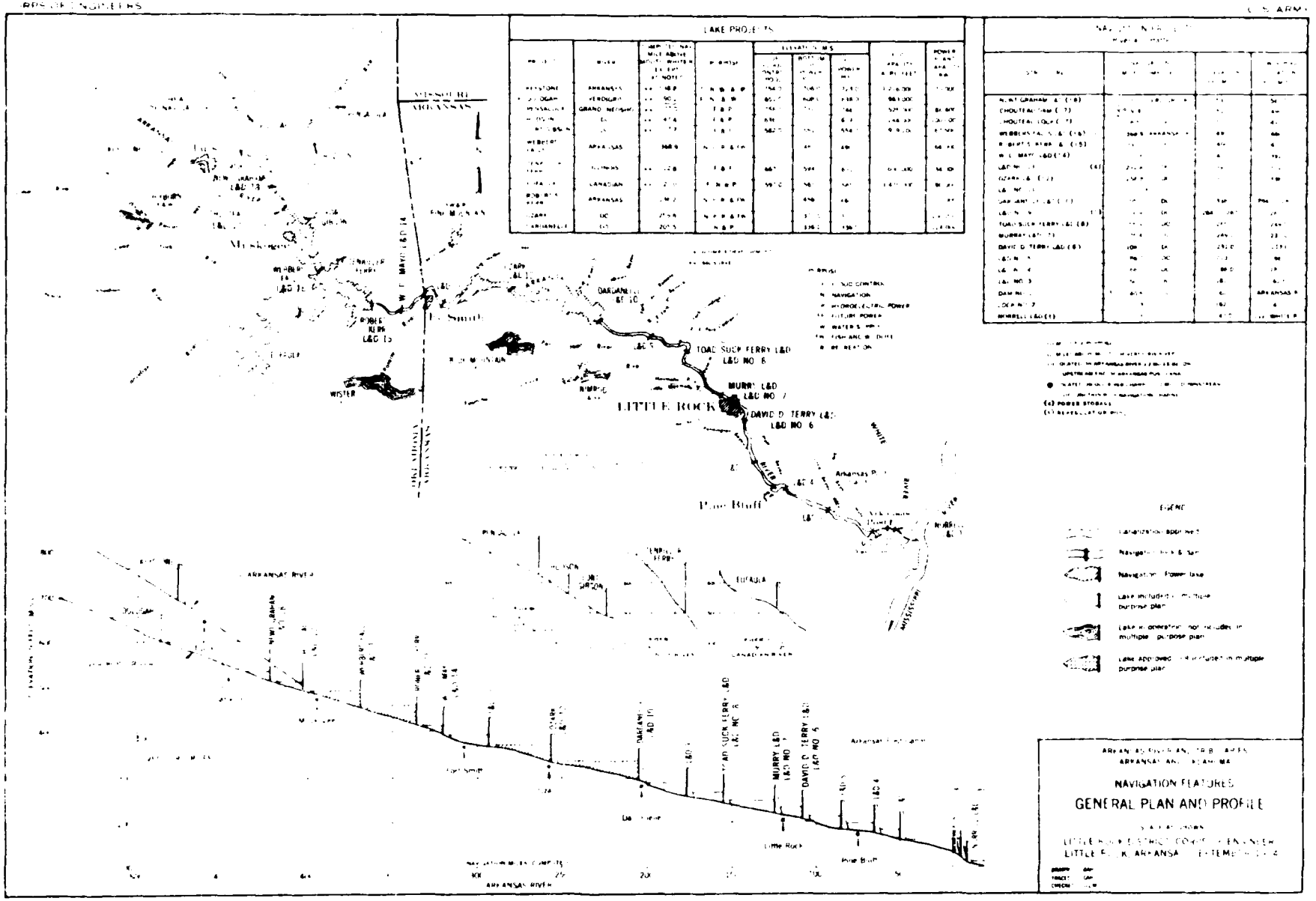

LAKE PROJECTS
NAVIGATION
LITTLE ROCK
Pine Bluff
MURRY L&D NO. 7
DAVID D. TERRY L&D NO. 6
TOAD SUCK FERRY L&D NO. 8
ROBERT S. KERR L&D 13
W. F. MARK L&D 14
DARDANELLE L&D 10
MEMPHIS
MISSISSIPPI
ARKANSAS
OKLAHOMA
TENNESSEE
MISSISSIPPI RIVER
ARKANSAS RIVER
LEGEND
Navigation locks & dam
Navigation - Power lake
Lake includes multiple purpose plan
Lake & generation not included in multiple purpose plan
Lake appurtenant to but not included in multiple purpose plan
NAVIGATION FEATURES
GENERAL PLAN AND PROFILE
LITTLE ROCK DISTRICT CORPS OF ENGINEERS
LITTLE ROCK, ARKANSAS

PLATE 3

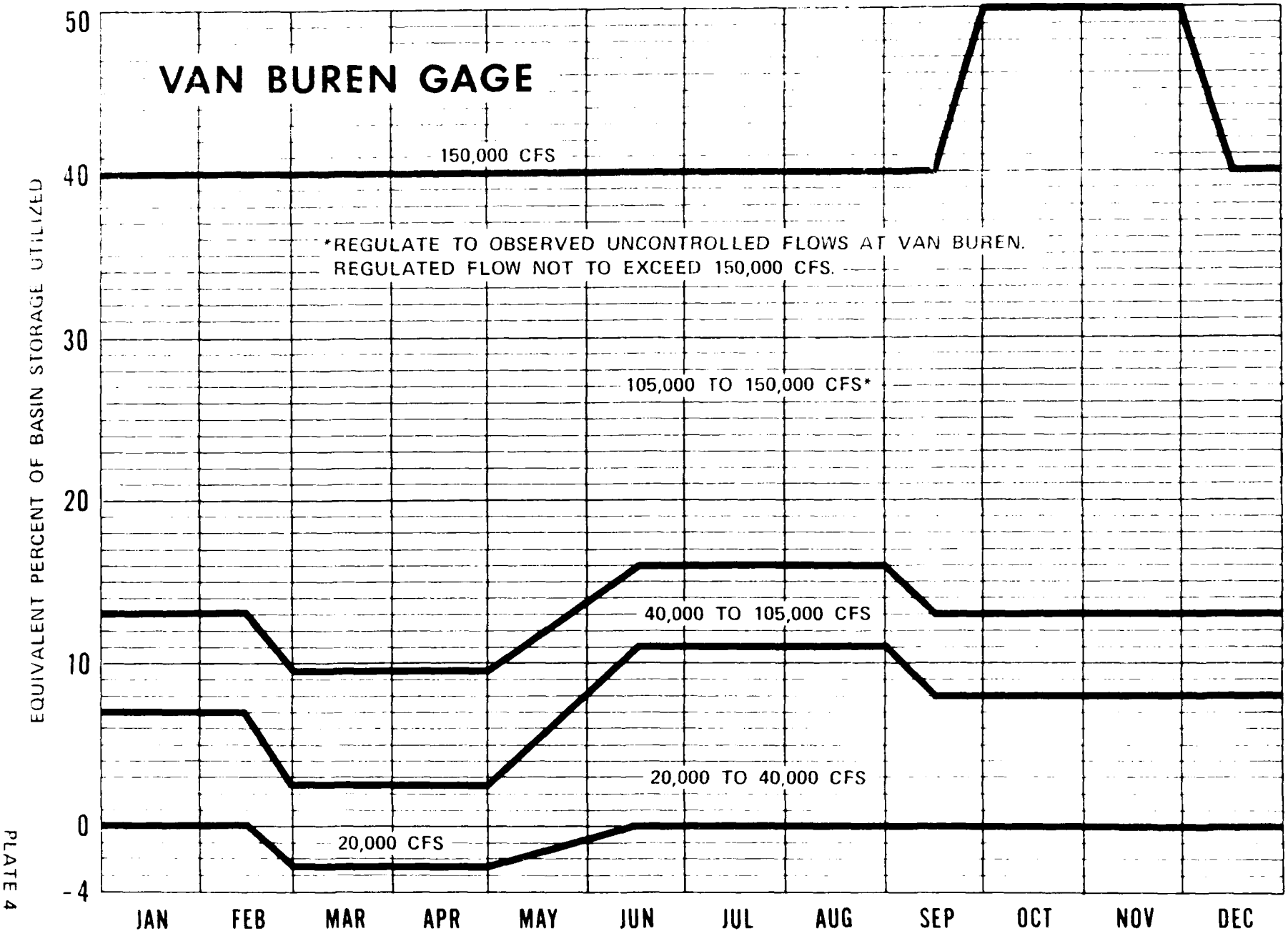
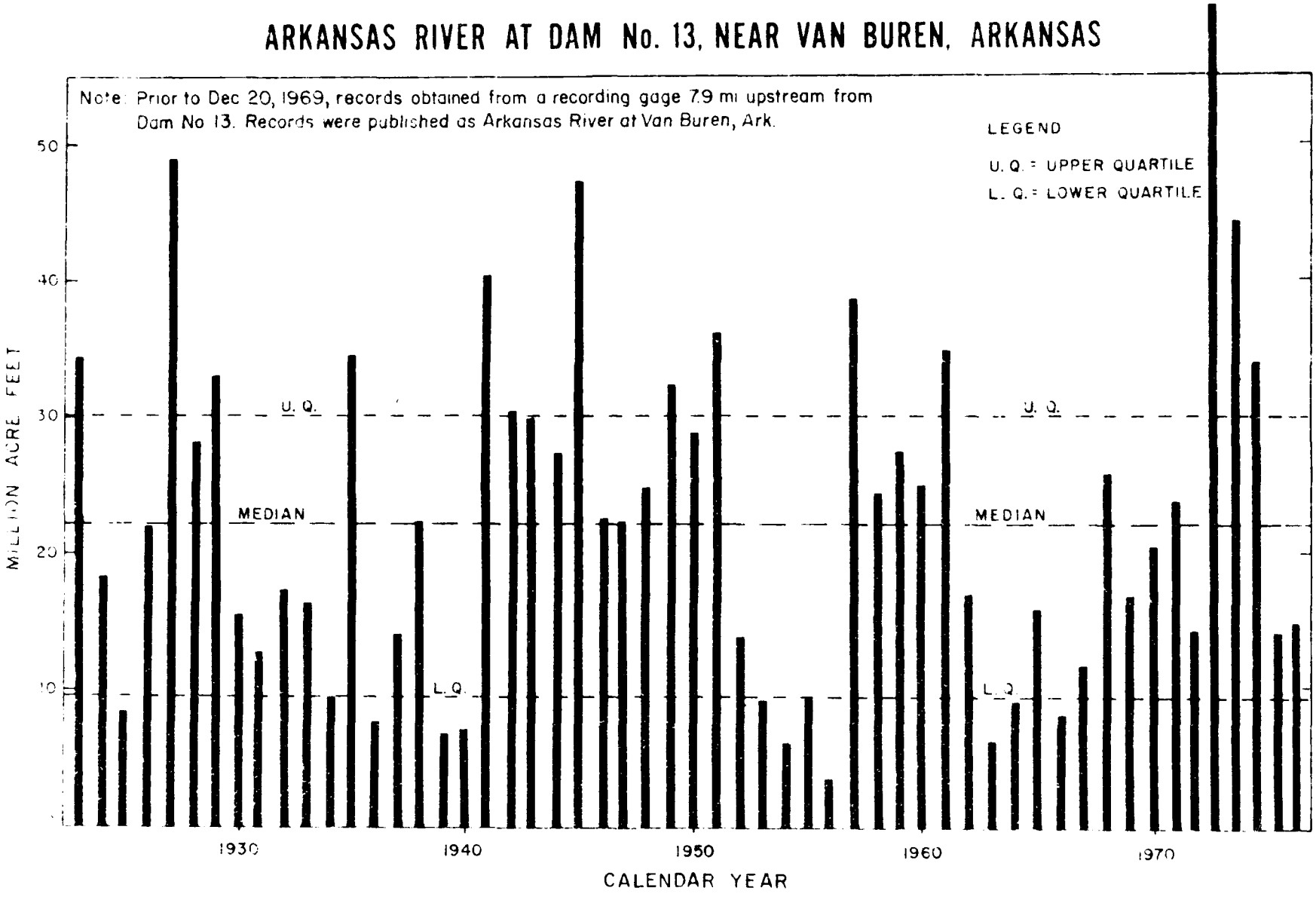

VAN BUREN GAGE
150,000 CFS
*REGULATE TO OBSERVED UNCONTROLLED FLOWS AT VAN BUREN.
REGULATED FLOW NOT TO EXCEED 150,000 CFS.
105,000 TO 150,000 CFS*
40,000 TO 105,000 CFS
20,000 TO 40,000 CFS
20,000 CFS
EQUIVALENT PERCENT OF BASIN STORAGE UTILIZED
50
40
30
20
10
0
-4
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

PLATE 4

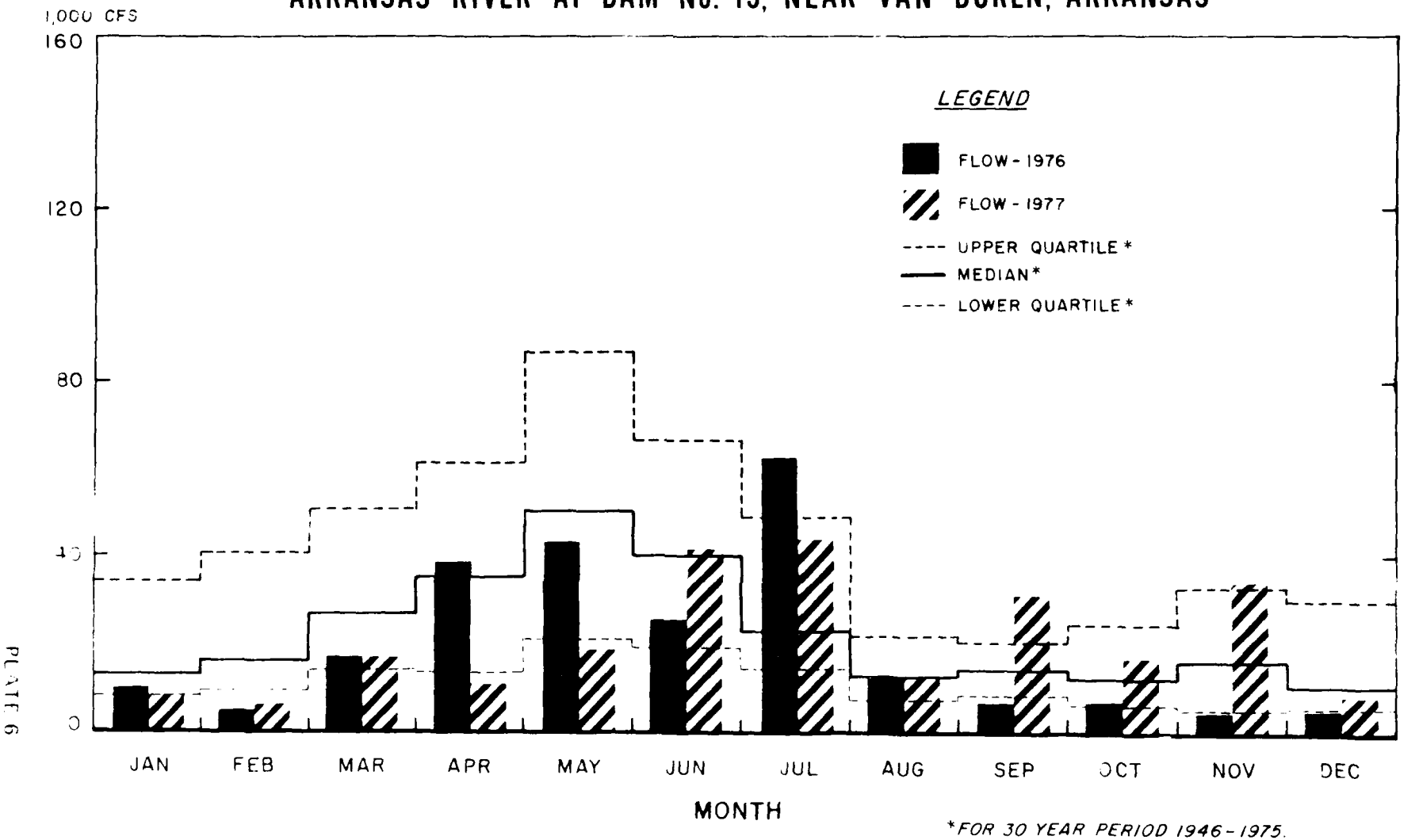
ANNUAL RECORDED FLOW

ARKANSAS RIVER AT DAM No. 13, NEAR VAN BUREN, ARKANSAS



AVERAGE MONTHLY RECORDED FLOWS

ARKANSAS RIVER AT DAM No. 13, NEAR VAN BUREN, ARKANSAS



*FOR 30 YEAR PERIOD 1946 - 1975.

PLATE 6

LOCK & DAM No. 13 - OUTFLOW HYDROGRAPH
1977

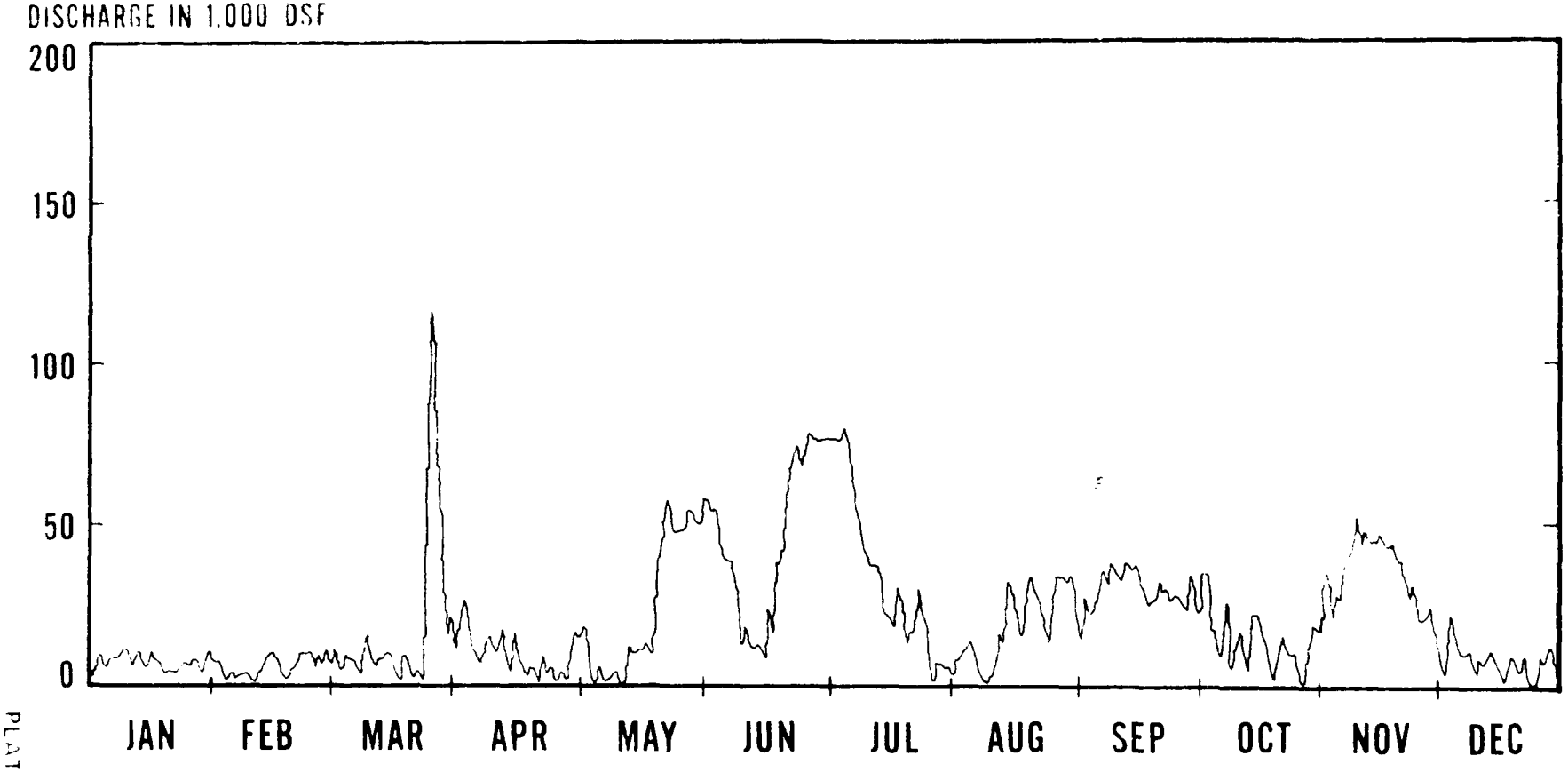


PLATE 7

KAW RESERVOIR

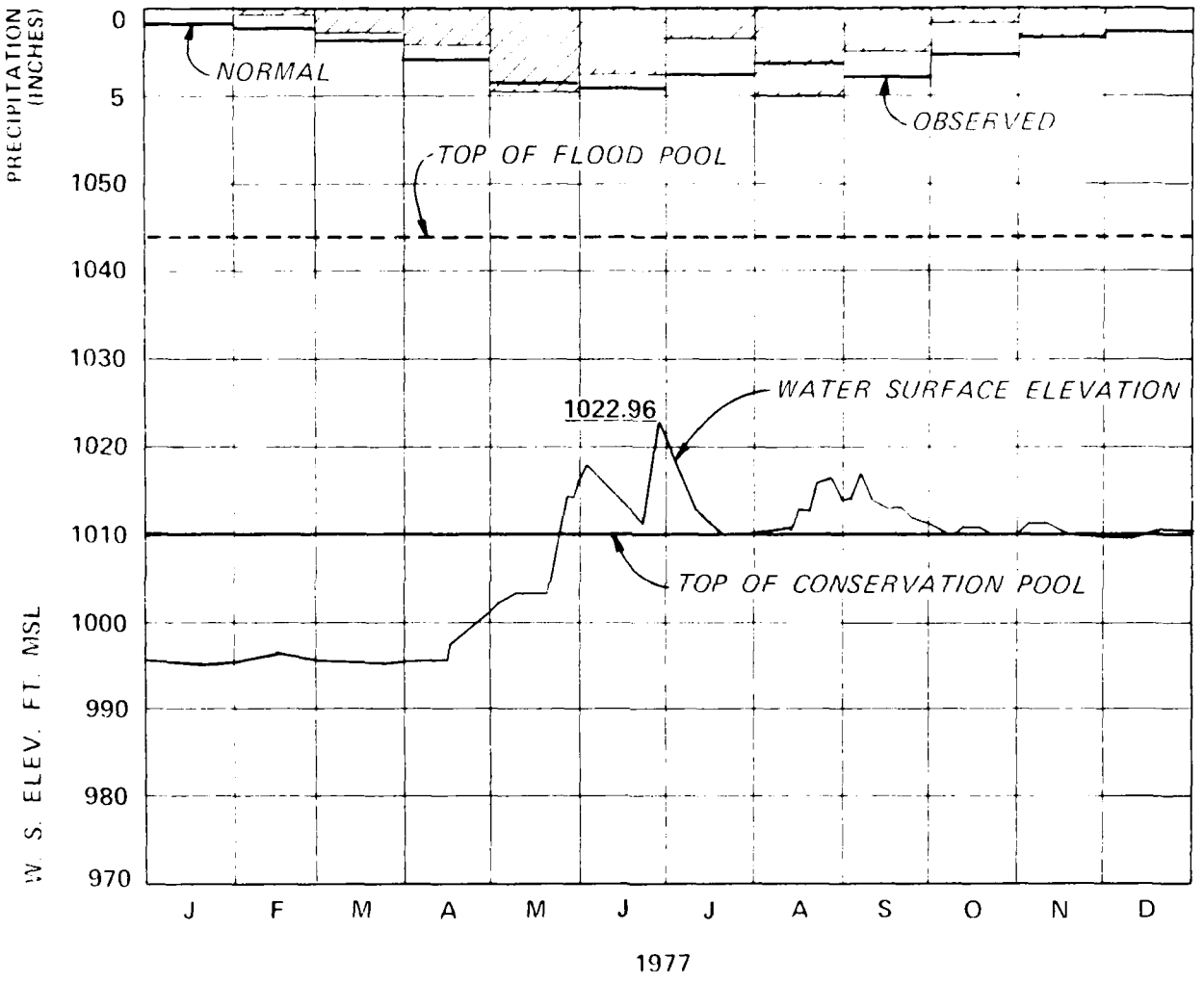
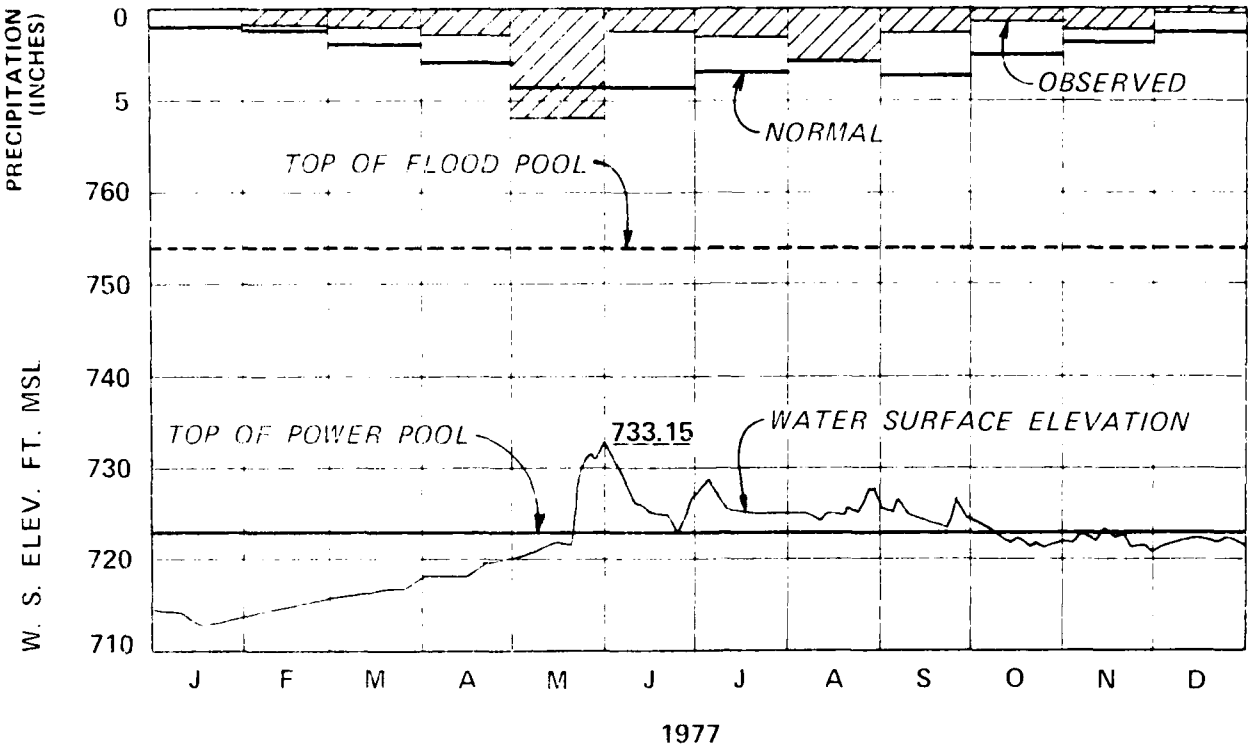


PLATE 8

KEYSTONE RESERVOIR



FALL RIVER RESERVOIR

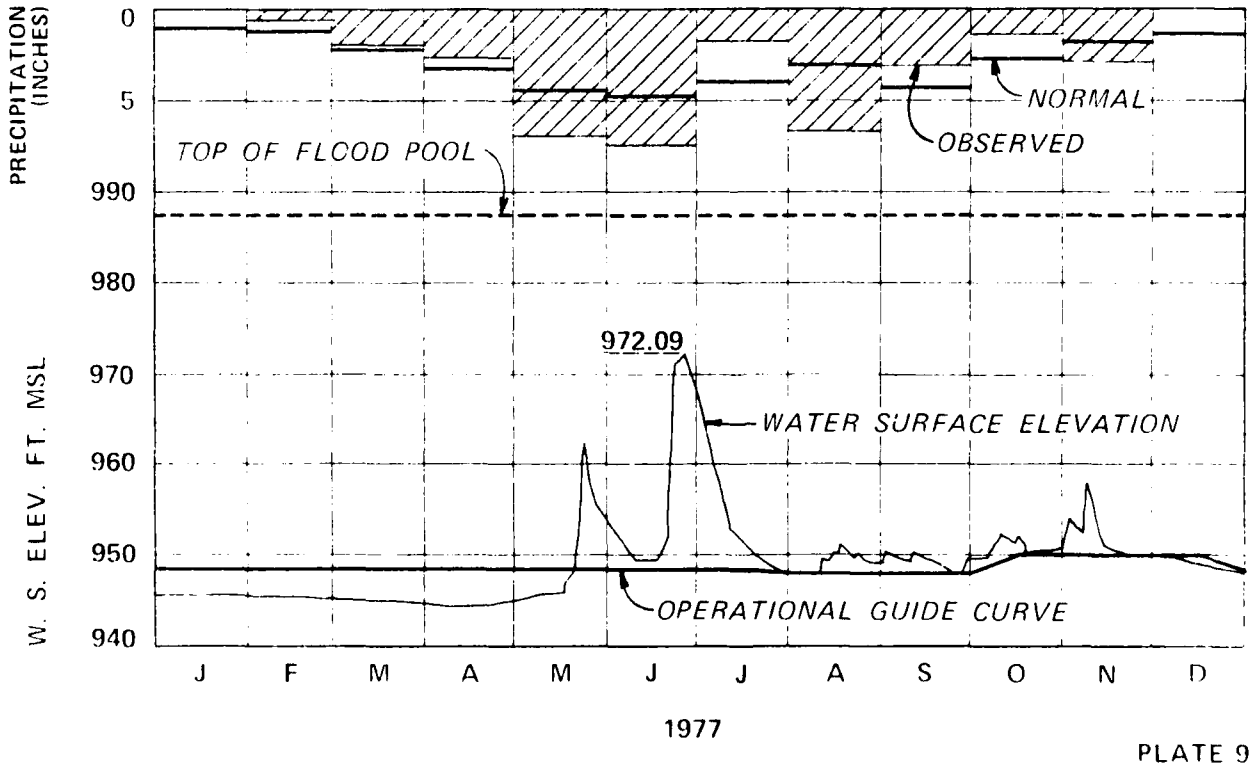
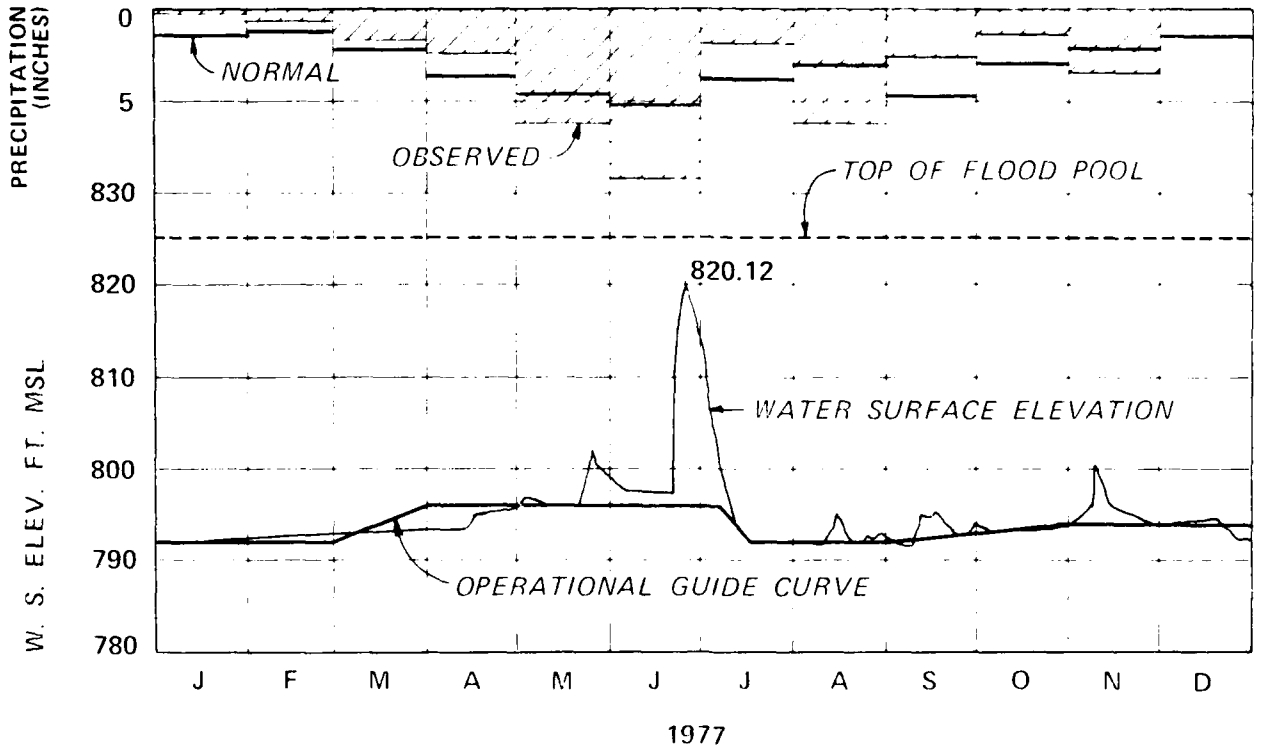


PLATE 9

ELK CITY RESERVOIR



OOLOGAH RESERVOIR

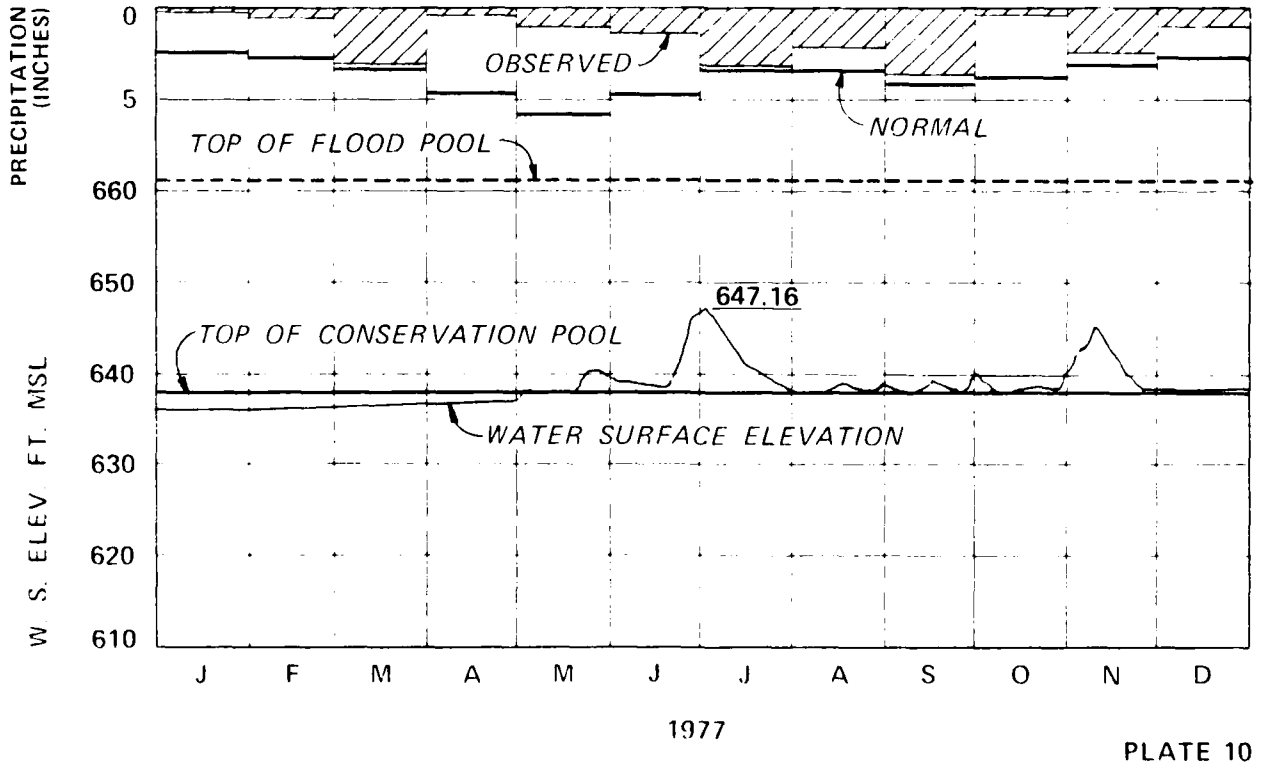
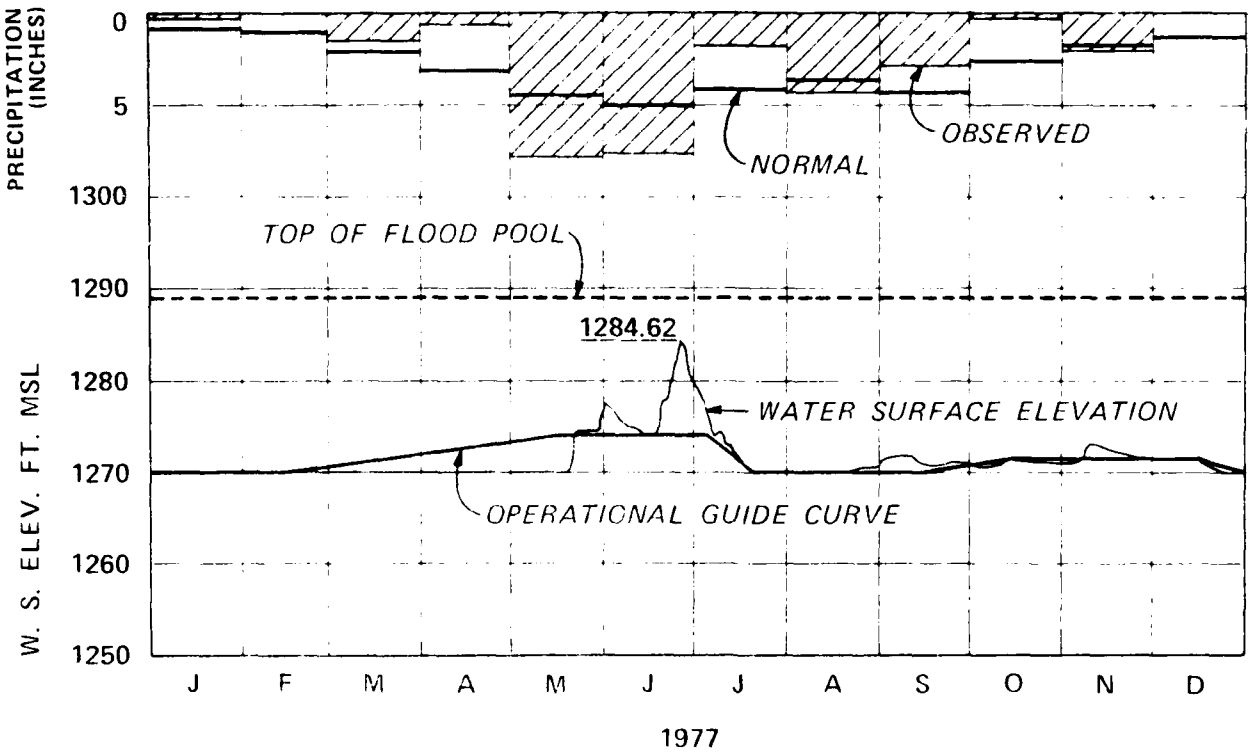


PLATE 10

COUNCIL GROVE RESERVOIR



JOHN REDMOND RESERVOIR

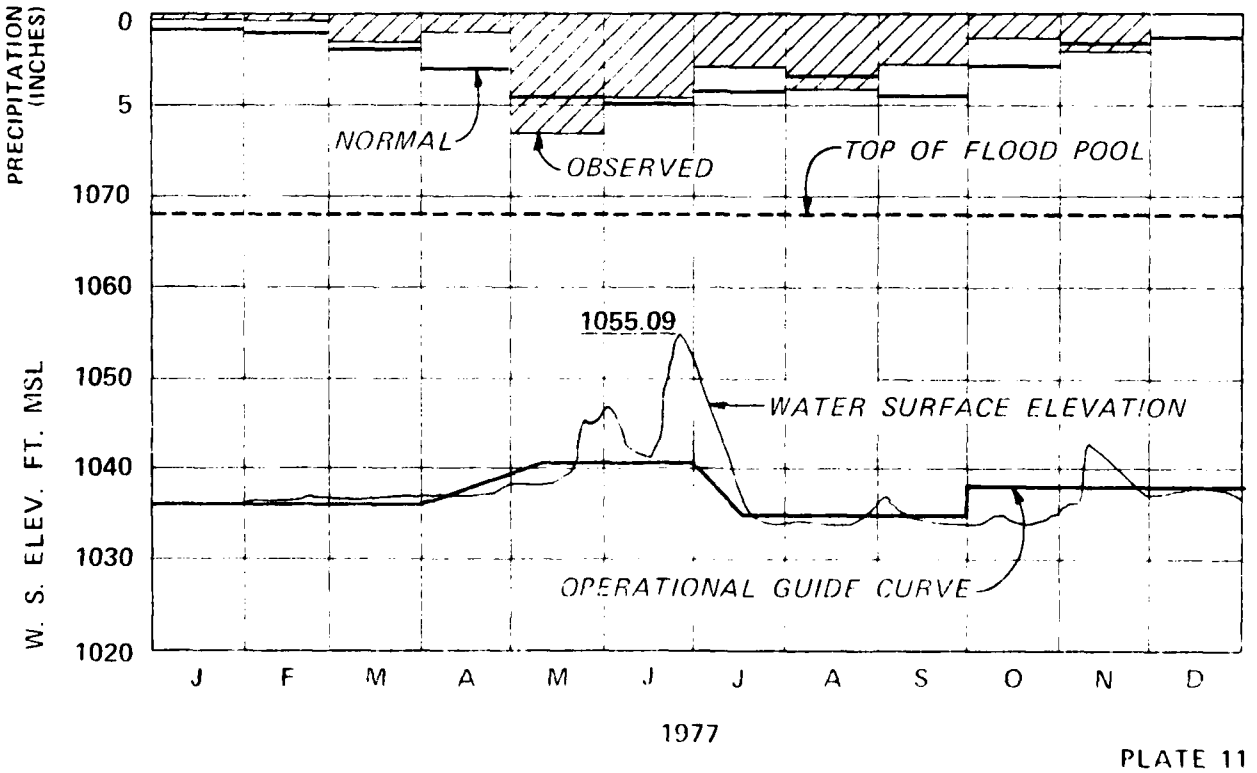
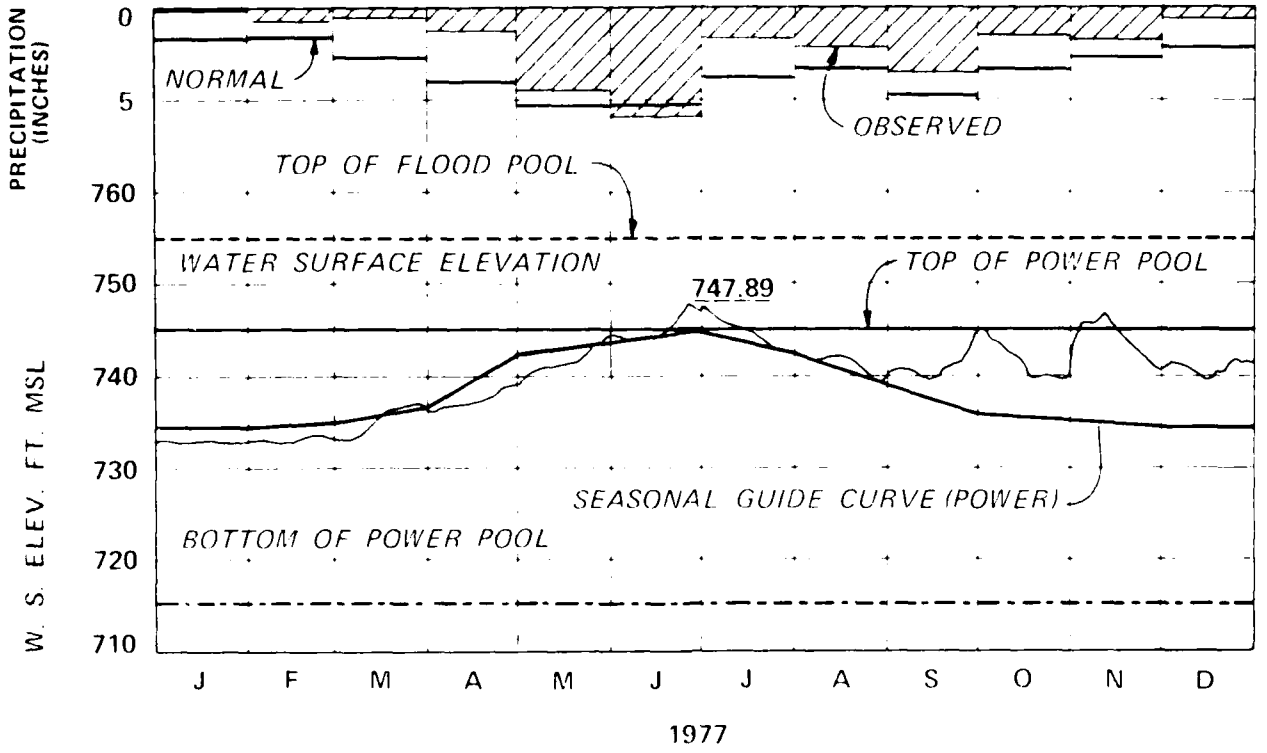


PLATE 11

GRAND LAKE (PENSACOLA) RESERVOIR



FT GIBSON RESERVOIR

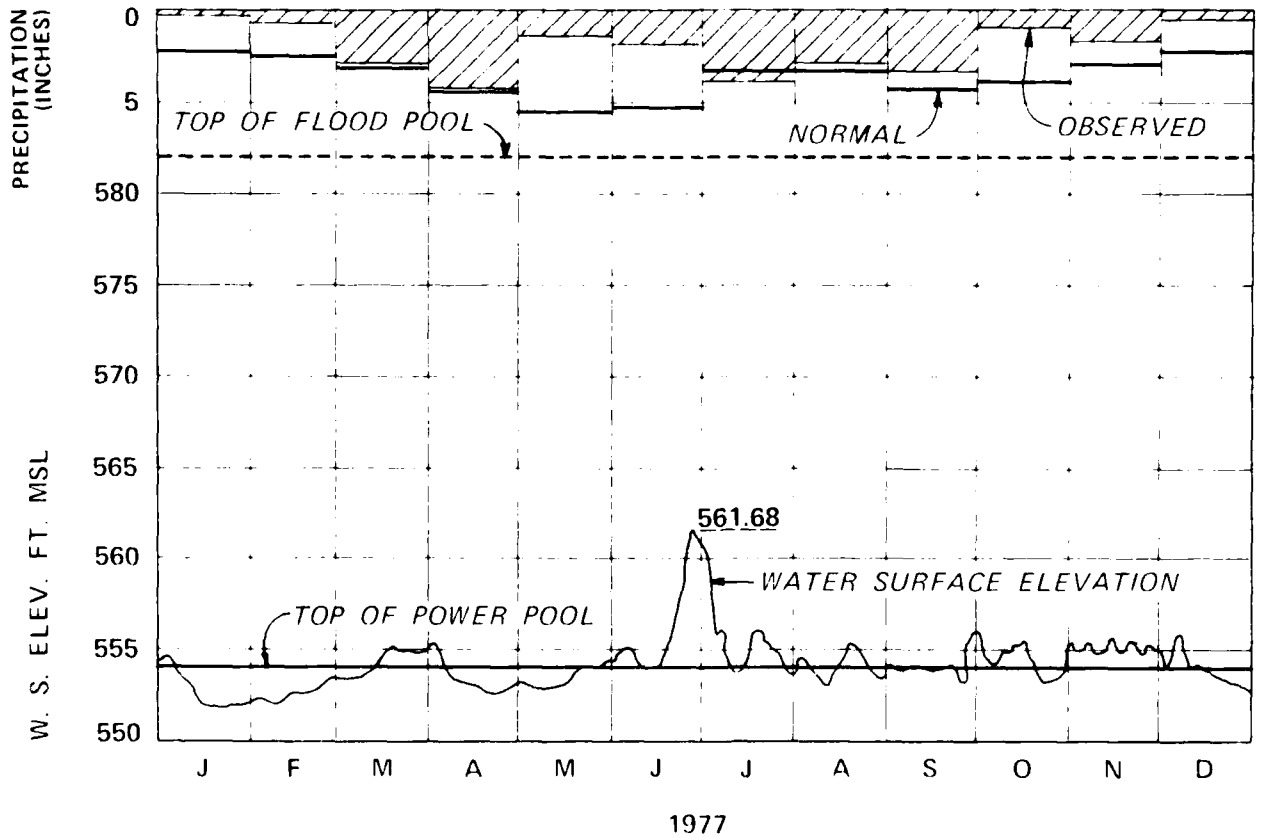


PLATE 12

TENKILLER RESERVOIR

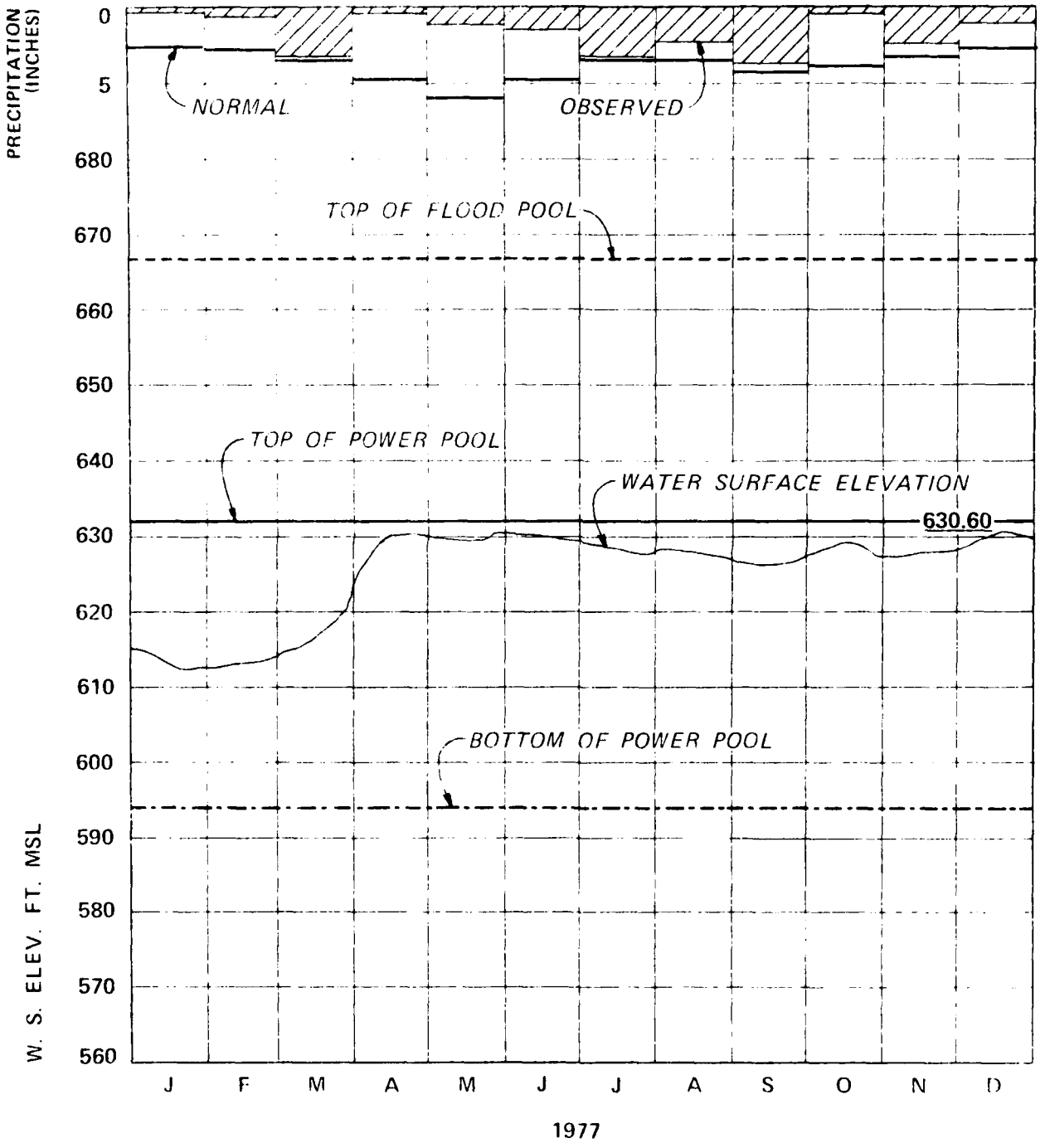
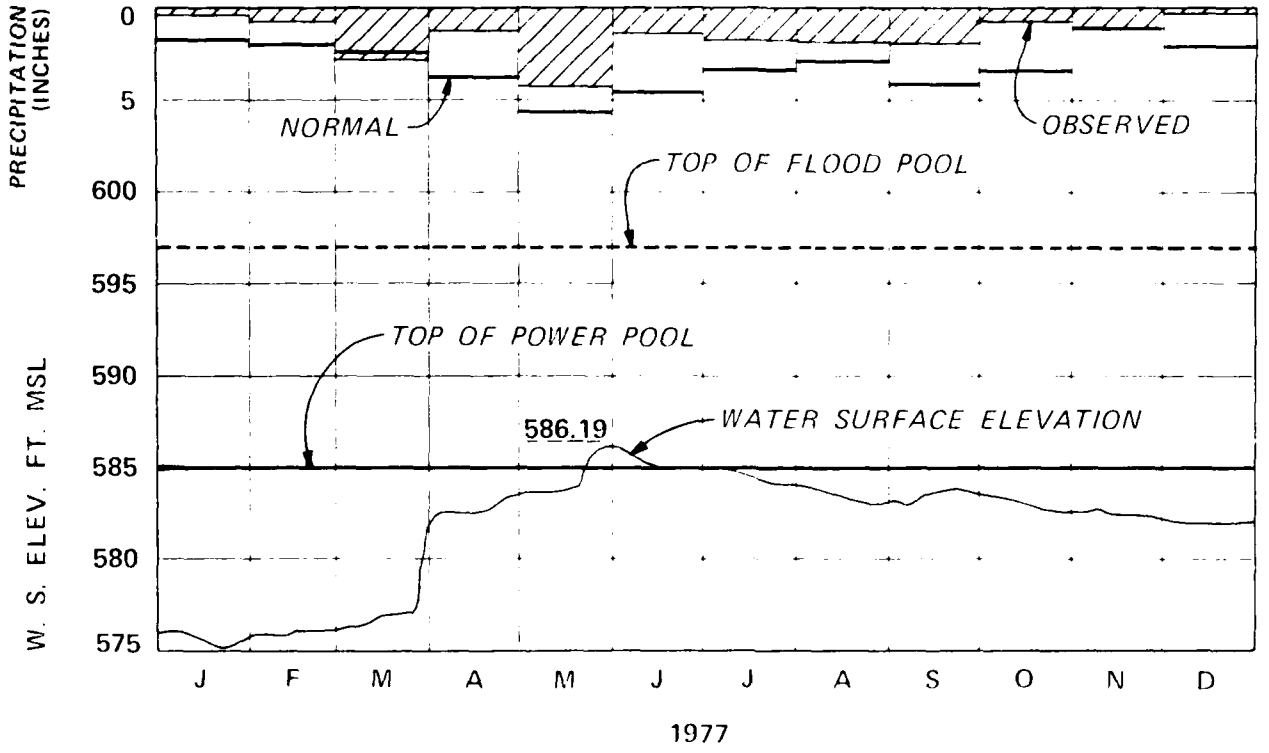


PLATE 13

EUFAULA RESERVOIR



WISTER RESERVOIR

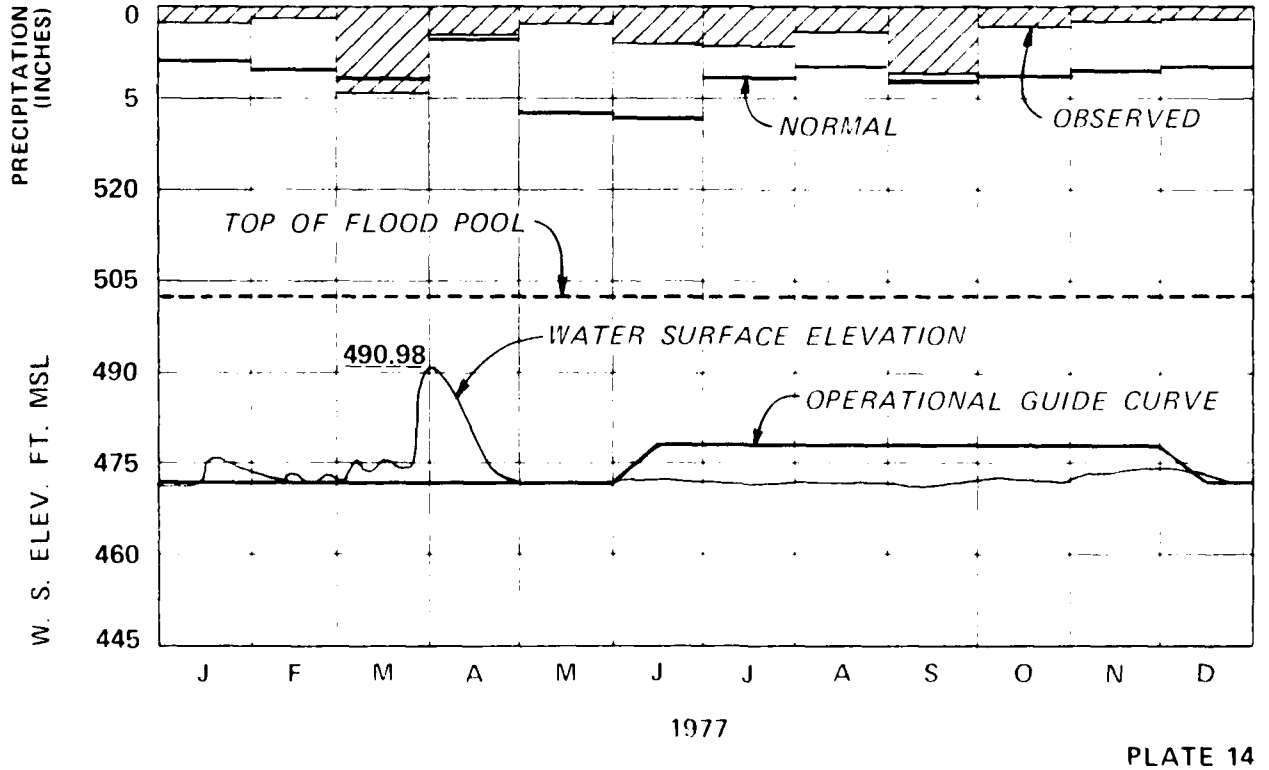
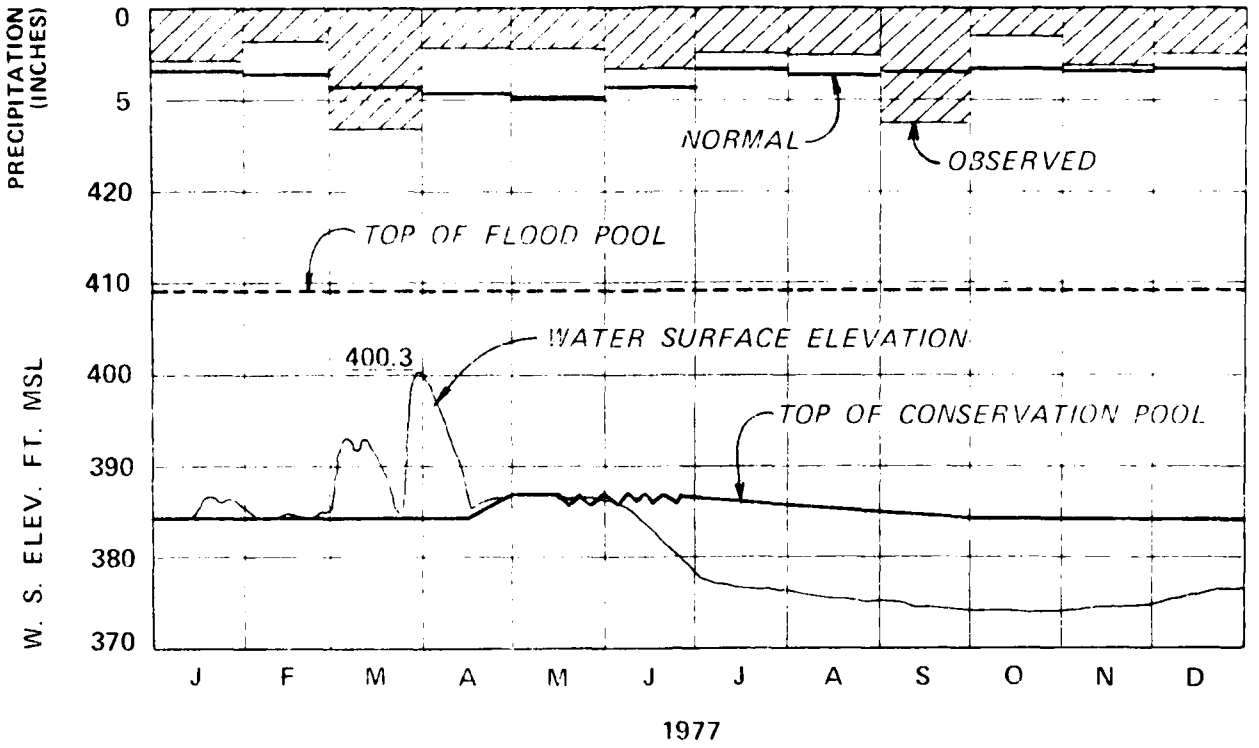


PLATE 14

BLUE MOUNTAIN RESERVOIR



NIMROD RESERVOIR

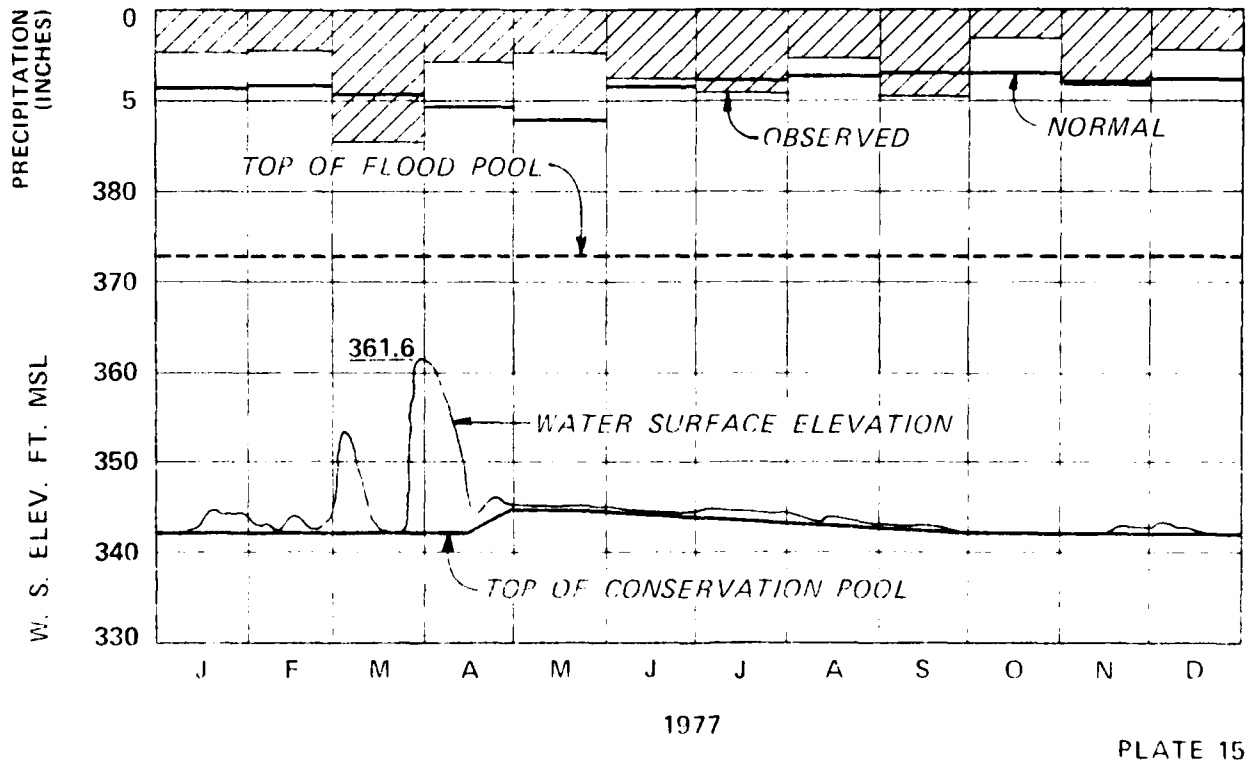


PLATE 15

FLOOD DAMAGES PREVENTED

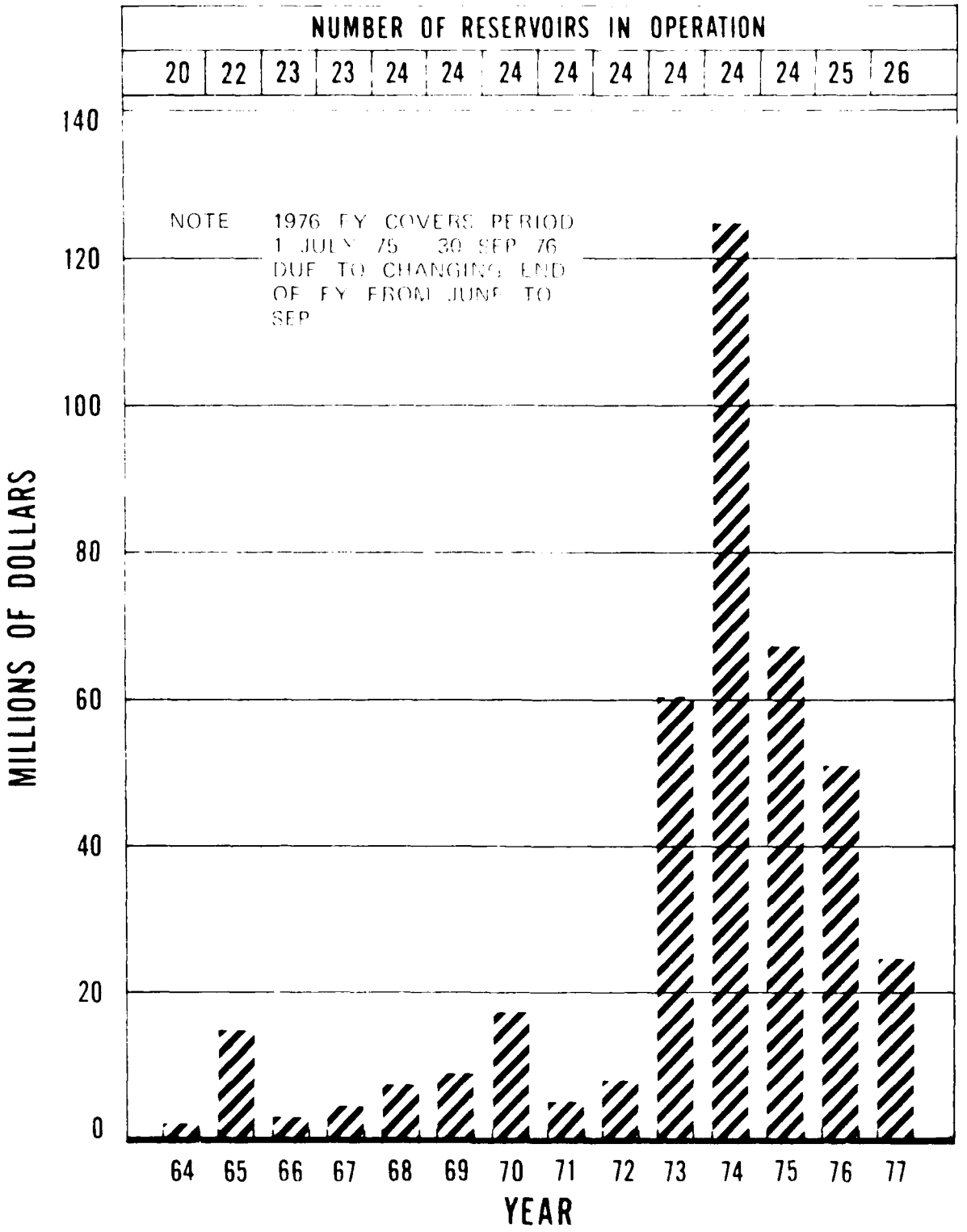
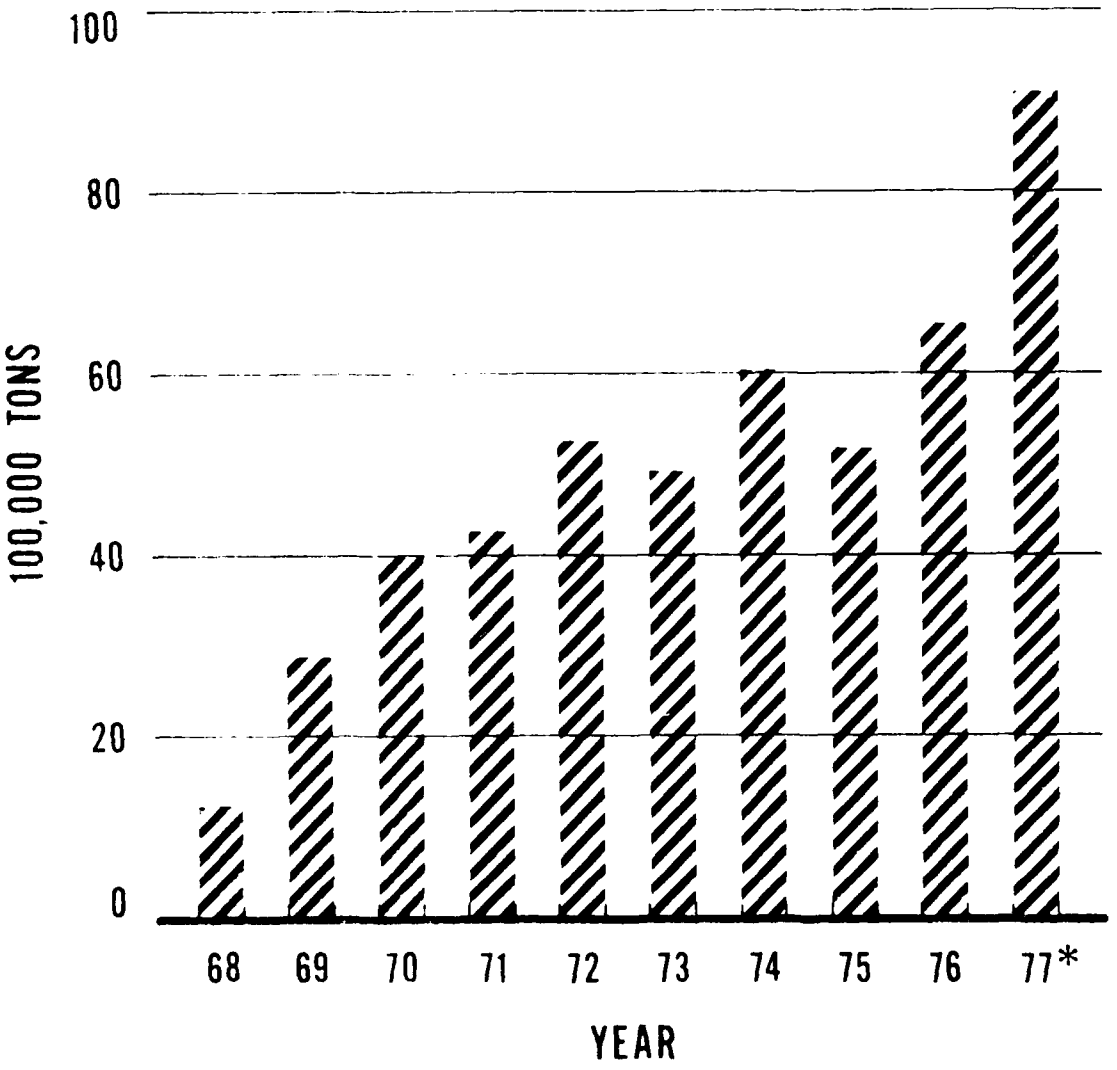


PLATE 16

FREIGHT TRAFFIC
McCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM

MOUTH OF WHITE RIVER TO PORT OF CATOOSA, OKLA



*Tonnage for 1977 based on preliminary estimates.

PLATE 17

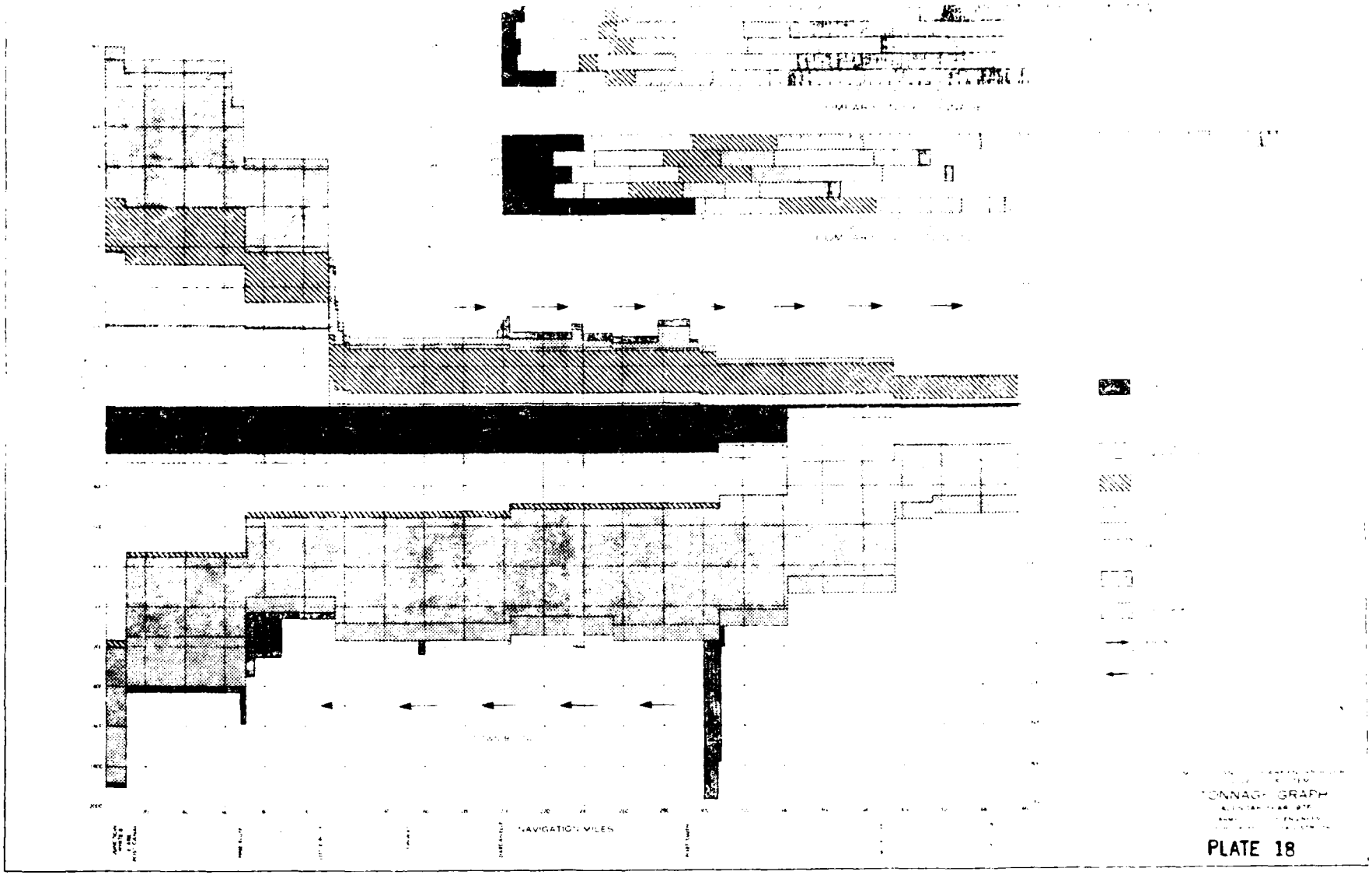


PLATE 18

COMMODITY GROUPS, TONNAGE, AND TON MILEAGE

[illegible]	Commodities Included	Tonnage	Ton Mileage
Coal and coke	Coal and lignite	234,[illegible]	80,08[illegible]
Aggregates	Sand, gravel, crushed rock	[illegible],281,[illegible]	17,366,8[illegible]
Grains	Corn	7,105	
	Wheat	261,795	
	Soybeans	533,257	
	Rice	86,868	
	Sorghum Grain	2,[illegible]	
		891,482	118,146,886
Chemicals and chemical fertilizers	Sodium hydroxide (caustic soda)	12[illegible],[illegible]	
	Alcohols	9,178	
	Benzene and toluene, crude and commercially pure	16,[illegible]	
	Basic chemicals and products not elsewhere classified	[illegible]3,27[illegible]	
	Synthetic rubber	1,604	
	Nitrogenous chemical fertilizers, except mixtures	[illegible],665	
	Phosphatic chemical fertilizers, except mixtures	4,[illegible]	
	Fertilizer and fertilizer materials, not elsewhere classified	[illegible],888	
		[illegible]13,59[illegible]	65,23[illegible],[illegible]
[Ores and minerals]	Bauxite and other aluminum ores and concentrates	[illegible],[illegible]32	
	Nonmetallic minerals, except fuels, not elsewhere classified	8,329	
	Manganese ores, concentrates	1,[illegible]	
	Nonferrous ores, concentrates NEC	12,98[illegible]	
		399,950	[illegible],8[illegible],581
Iron and steel	Iron and steel ingots, and other primary forms, including blanks for tube and pipe, and sponge iron	3[illegible],[illegible]	
	Iron and steel shapes, exc sheet	55,44[illegible]	
	Iron and steel plates and sheets	138,425	
	Iron and steel pipe and tube	[illegible]	
	Ferroalloys	[illegible]	
	Primary iron and steel products, not elsewhere classified	[illegible]	
	Iron and steel scrap	[illegible],563	
		269,[illegible]	85,616,[illegible]18
[Petroleum products]	Distillate fuel oil	17[illegible],[illegible]	
	Gasoline	6,308	
	Residual fuel oil	1,068,38[illegible]	
		[illegible],[illegible],969	280,42[illegible],173
[All other]	Asphalt, tar, and pitches	19,121	
	Prepared animal feeds	6[illegible],598	
	Molasses	3[illegible],5[illegible]9	
	Logs	49,176	
	Pulpwood, log	9,[illegible]	
	Lumber	2,096	
	Slag	9,13[illegible]	
	Pulp	2,430	
	Miscellaneous manufacturing products	[illegible]2	
	Paper and paper board	100,665	
	Crude Petroleum	30,991	
	Fabricated metal products	2,218	
	Machinery, except electrical	[illegible]	
	Phosphate rock	6,27[illegible]	
	Materials used in waterway improvement, government materials	37[illegible],621	
	Hay and fodder	[illegible],212	
	Timber, posts, poles, pilings	1,215	
	Pulp and paper products, NEC	1[illegible],9[illegible]	
	Grain mill products, NEC	2[illegible],[illegible]	
	Electrical machinery and equipment	[illegible]66	
	Miscellaneous transportation equipment		
	[illegible]	2[illegible],[illegible]	
	[illegible]	[illegible]	
	[illegible]	[illegible]	
		[illegible]	[illegible]

EXHIBIT 1

Rule Curves for Hydroelectric Power Projects

Operating rule curves have been developed for Keystone, Tenkiller Ferry, and Eufaula Lakes. The curves were developed to provide for better coordination between the Corps of Engineers and the Southwestern Power Administration (SWPA) in the operation of the hydroelectric power projects. A description of the use of these curves and a graph showing the location of the zones in the pool for each project are shown on the following pages.

Fort Gibson, Webbers Falls, R. S. Kerr, Ozark, and Dardanelle are "run-of-river" projects with limited storage, therefore, rule curve operations are not applicable for these projects.

KEYSTONE LAKE

DESCRIPTION FOR USE
OF RULE CURVES

ZONE I

1. Description. Flood Control Zone Above Zone II.

2. Operational Objectives.

a. Protect downstream reaches.

b. Minimize damages within flood pool.

c. Restore flood control capability by emptying as soon as possible.

3. Operational Constraints. Releases would be made in accordance with flood control requirements for the Arkansas River System.

4. Declaration of Energy Available.

a. Downstream not limiting - 24 hours per day at plant capacity. (Daily)

b. Downstream limiting - Up to allowable release but usually not less than firm energy. (Daily)

5. Frequency of Contact with SWPA.

a. Daily or more often if needed - furnish SWPA best forecast of inflows, pool elevations, and constraints, if limited by downstream channel capacity.

b. Try to give at least 48 hours notice of the following conditions:

(1) Time to change from firm energy to full gate or vise versa.

(2) Time pool will fall into Zone II.

6. Degree of Corps Control. Absolute.

ZONE II

1. Description. Transition Zone from Flood Control to Conservation Operation.

2. Operational Objectives.

a. Supplement hydropower and purposes other than flood control when possible through transition from large flood control releases to moderate power releases.

b. Minimize damage to downstream channel banks due to rapid reduction of flow when banks are saturated.

c. Increase energy production by eliminating unnecessary spills.

d. Control minor rises into flood control pool without spill or short duration releases at high flood control release rates.

e. Provide for minor volumes of carry-over storage for desirable effects such as navigation tapers and "Great Raft Race."

3. Operational Constraints.

a. Limit duration in transition zone to minimize damages to lake shore and recreation developments.

b. The maximum expected release will be about 12,000 c.f.s. (plant capacity). Minimize release will be the rate that will draw the pool down in a reasonable time considering downstream needs such as navigation, low flows, etc.

4. Declaration of Energy Available.

a. Compute energy equivalent of releases required to meet operational constraints. (Daily)

5. Frequency of Contact with SWPA.

a. Daily - furnish SWPA best forecast of inflows, pool elevations, and constraints.

b. Try to give at least 48-hour notice of the following conditions:

(1) Time pool will rise into Zone I.

(2) Time pool will fall into Zone III.

c. Daily - obtain SWPA power schedule.

6. Degree of Corps Control. Absolute.

ZONE III

1. Description. Flexible Conservation Zone.

2. Operational Objectives.

a. Exercise best judgment in achieving conservation storage benefits.

b. Allow maximum utilization of power production potential which will not adversely affect other project uses.

c. Supplement flood control potential when possible.

3. Operational Constraints.

a. Exercise minimum amount of constraint on operations based on best judgment.

b. Sufficient generation must be made to satisfy downstream low flow requirements (presently estimated to be 200 cfs). Generate at least once every three days to replenish oxygen content of water in the spillway stilling basin.

c. Limit drawdown to a maximum of 1 foot per week.

4. Declaration of Energy Available.

a. Allocation will be plant capacity or estimated inflow plus one foot of drawdown per week, whichever is less, unless exceeded by firm power or required downstream flow.

5. Frequency of Contact with SWPA.

a. Daily - furnish SWPA with best forecast of inflows.

b. Daily - obtain SWPA power schedule.

c. Weekly - furnish SWPA with recommended maximum energy production.

d. Monthly - furnish SWPA with recommended energy production and discuss production plans at monthly power schedule meeting.

6. Degree of Corps Control.

a. On energy production - normally negotiable.

b. On utilization of specific carry-over storage from Zone II operations - Absolute.

ZONE IV

1. Description. Design Purpose Conservation Storage Zone.

2. Operational Objectives.

a. Operate the project as nearly as possible to meet the design power while recognizing other project uses.

3. Operational Constraints.

a. Cumulative use by competitors for conservation storage must fall within reasonable limits, although seasonal or short-term flexibility may be allowed.

b. Weekly firm energy must be scheduled in a manner that will satisfy downstream minimum flow requirements. For example, one-third of the weekly firm energy could be generated on Monday, Wednesday, and Friday.

c. Generation should be scheduled at least every three days to replenish the oxygen content of water in the spillway stilling basin.

4. Declaration of Energy Available.

a. During the months of June through September, the allocation will be firm power, a weekly average of 6400 kw (9.14 plant factor).

b. For the other months of the year (October through May), the weekly allocation will be determined based on the pool elevation and the release needed to satisfy minimum downstream flow requirements (an estimated average weekly release of 250 cfs is required to maintain a minimum instantaneous discharge of 200 cfs past the Tulsa gage).

c. Declare energy available on a monthly basis according to subparagraphs a and b minus any cumulative over production or plus any cumulative under production since first entering Zone IV.

5. Frequency of Contact with SWPA.

a. Daily or more often as needed - furnish SWPA with best forecast of inflows.

ZONE IV (CONT)

5. Frequency of Contact with SWPA. (Cont)

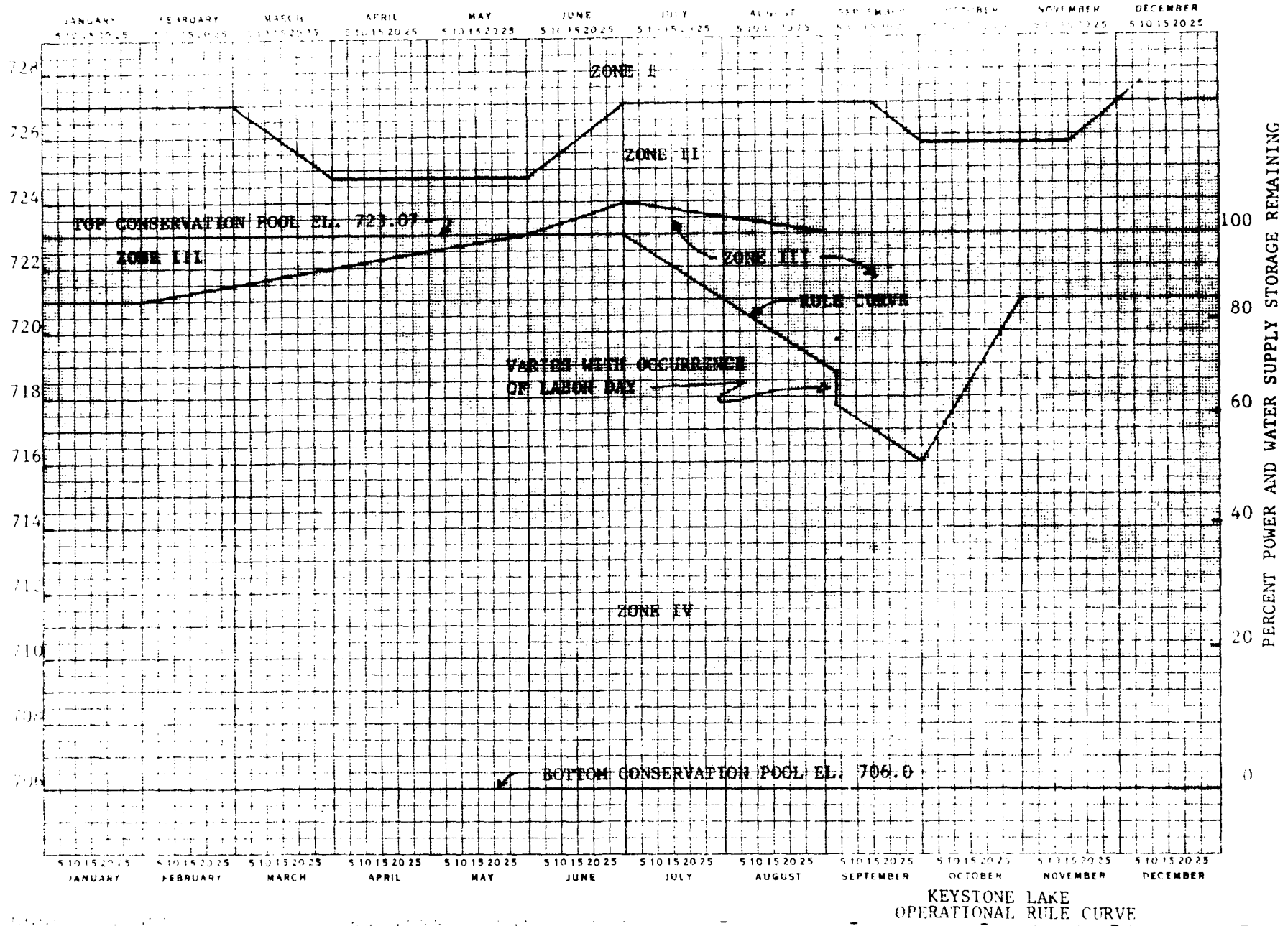
b. Daily - obtain SWPA power schedules.

c. Monthly - furnish SWPA declaration of energy according to firm capability of the project.

d. Monthly - discuss cumulative deviations of actual generation from firm capability and encourage rectification of this deviation.

6. Degree of Corps Control.

a. Negotiable to the extent that the only hydropower made over and above our allocation would be due to extenuating circumstances such as all possible purchases of power from other sources has been exhausted. Corps would maintain absolute control over minimum releases.



KEYSTONE LAKE
OPERATIONAL RULE CURVE

TENKILLER FERRY LAKE

DESCRIPTION FOR USE
OF RULE CURVES

ZONE I

1. Description. Flood Control Zone Above Zone II.

2. Operational Objectives.

a. Protect downstream reaches.

b. Minimize damages to within flood pool.

c. Restore flood control capability as soon as possible.

3. Operational Constraints. Releases would be made in accordance with flood control requirements for the Arkansas River System.

4. Declaration of Energy Available.

a. Downstream not limiting - 24 hours per day at plant capacity. (Daily)

b. Downstream limiting - Up to allowable release but usually not less than firm energy. (Daily)

5. Frequency of Contact with SWPA.

a. Daily or more often if needed - furnish SWPA best forecast of inflows, pool elevations, and constraints, if limited by downstream channel capacity.

b. Try to give at least 48-hour notice of the following conditions:

(1) Time to change from firm energy to full gate or vise versa.

(2) Time pool will fall into Zone II.

6. Degree of Corps Control. Absolute.

ZONE II

1. Description. Transition Zone From Flood Control To Conservation Operation.

2. Operational Objectives.

a. Supplement hydropower and purposes other than flood control when possible through transition from large flood control releases to moderate power releases.

b. Minimize damage to downstream channel banks due to rapid reduction of flow when banks are saturated.

c. Increase energy production by eliminating unnecessary spills.

d. Control minor rises into flood control pool without spill or short duration releases at high flood control release rates.

e. Provide for minor volumes of carry-over storage for desirable effects such as navigation taper.

3. Operational Constraints.

a. Limit duration in transition zone to minimize damages to lake shore and recreation developments.

b. The maximum expected release will be about 3,300 cfs (plant capacity). Minimum release will be the rate that will draw the pool down in a reasonable time considering downstream needs such as navigation, low flows, etc.

4. Declaration of Energy Available.

a. Compute energy equivalent of releases required to meet operational constraints. (Daily)

5. Frequency of Contact with SWPA.

a. Daily - furnish SWPA best forecast of inflows, pool elevations, and constraints.

b. Try to give at least 48-hour notice of the following conditions:

(1) Time pool will rise into Zone I.

(2) Time pool will fall into Zone III.

c. Daily - obtain SWPA power schedule.

6. Degree of Corps Control. Absolute.

ZONE III

1. Description. Flexible Conservation Zone.

2. Operational Objectives.

a. Exercise best judgment in achieving conservation storage benefits.

b. Allow maximum utilization of power production potential which will not adversely affect other project uses.

c. Supplement flood control potential when possible.

3. Operational Constraints.

a. Exercise minimum amount of constraint on operations based on best judgment.

b. Limit drawdown to not more than one-half foot per week.

c. The minimum generation would be one unit for one hour each day.

4. Declaration of Energy Available.

a. Allocation will be plant capacity or estimated inflow plus a maximum of one-half foot of drawdown per week, whichever is less, unless exceeded by firm energy.

5. Freqneucy of Contact with SWPA.

a. Daily - furnish SWPA with best forecast of inflows.

b. Daily - obtain SWPA power schedule.

c. Weekly - furnish SWPA with recommended maximum energy production.

d. Monthly - furnish SWPA with recommended energy production and discuss production plans at monthly power schedule meeting.

6. Degree of Corps Control.

a. On energy production - normally negotiable.

b. On utilization of specific carry-over storage from Zone II operations - Absolute.

ZONE IV

1. Description. Design Purpose Conservation Storage Zone.

2. Operational Objectives.

a. Operate the project as nearly as possible to meet the design power while recognizing other project uses.

b. Monitor all competitive uses of conservation storage to assure equity.

3. Operational Constraints.

a. Cumulative use by competitors for conservation storage must fall within reasonable limits, although seasonal or short-term flexibility may be allowed.

b. One unit will be scheduled for at least one hour each day.

4. Declaration of Energy Available.

a. Allocation will be the firm energy of the project under current conditions (lake capacities, tailwater elevations, monthly distribution of firm energy, etc.) for the critical hydro period.

b. Declare energy available on a monthly basis according to subparagraph a minus any cumulative over production or plus any cumulative under production since first entering Zone IV.

5. Frequency of Contact with SWPA.

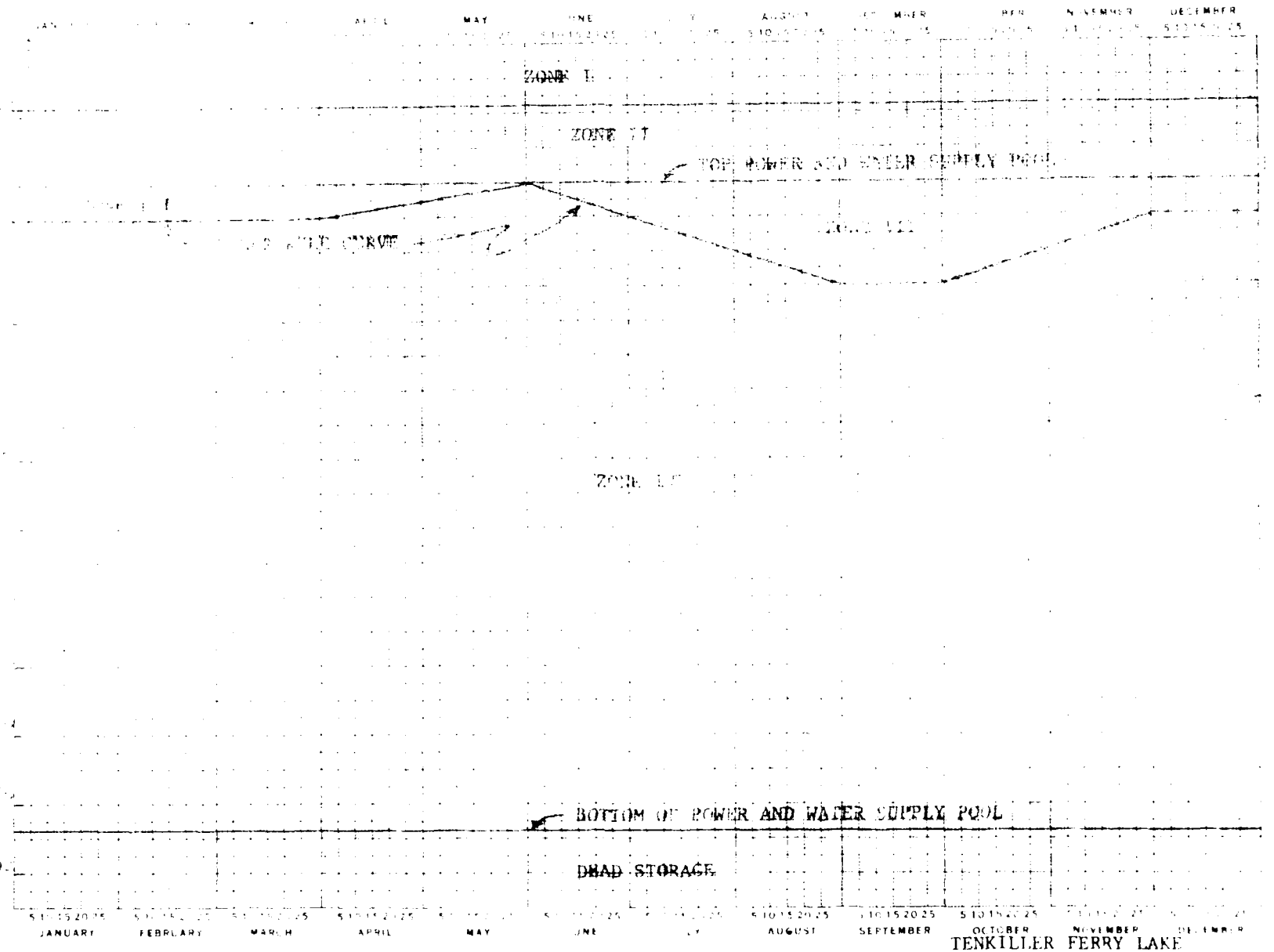
a. Daily or more often as needed - furnish SWPA with best forecast of inflows.

b. Daily - obtain SWPA power schedules.

c. Monthly - furnish SWPA declaration of energy according to firm or primary capability of the project.

d. Monthly - discuss cumulative deviations of actual generation from firm or primary capability and encourage rectification of this deviation.

6. Degree of Corps Control. Negotiable to the extent that the only hydropower made over and above our allocation would be due to extenuating circumstances such as all possible purchase of power from other sources has been exhausted. Corps would maintain absolute control over minimum releases.



TENKILLER FERRY LAKE
OPERATIONAL RULE CURVES

EUFAULA

DESCRIPTION FOR USE
OF RULE CURVES

ZONE I

1. Description. Flood Control Zone Above Zone II.

2. Operational Objectives.

a. Protect downstream reaches.

b. Minimize damages to lake banks within flood pool.

c. Restore flood control capability as soon as possible.

3. Operational Constraints. Releases would be made in accordance with flood control requirements for the Arkansas River System.

4. Declaration of Energy Available.

a. Downstream not limiting - 24 hours per day at plant capacity. (Daily)

b. Downstream limiting - Up to allowable release but usually not less than firm energy. (Daily)

5. Frequency of Contact with SWPA.

a. Daily or more often if needed - furnish SWPA best forecast of inflows, pool elevations, and constraints, if limited by downstream channel capacity.

b. Try to give at least 48 hours notice of the following conditions:

(1) Time to change from firm energy to full gate or vise versa.

(2) Time pool will fall into Zone II.

6. Degree of Corps Control. Absolute.

ZONE II

1. Description. Transition Zone From Flood Control to Conservation Operation.

2. Operational Objectives.

a. Supplement hydropower and purposes other than flood control when possible through transition from large flood control releases to moderate power releases.

b. Minimize damage to downstream channel banks due to rapid reduction of flow when banks are saturated.

c. Increase energy production by eliminating unnecessary spills.

d. Control minor rises into flood control pool without spill or short duration releases at high flood control release rates.

e. Provide for minor volumes of carry-over storage for desirable effects such as navigation taper.

3. Operational Constraints.

a. Limit duration in transition zone to prevent damages to lake shore and recreation developments.

b. The maximum expected release will be about 13,300 cfs (plant capacity). Minimum release will be the rate that will draw the pool down in a reasonable time considering downstream needs such as navigation, low flows, etc.

4. Declaration of Energy Available.

a. Compute energy equivalent of releases required to meet operational constraints. (Daily)

5. Frequency of Contact with SWPA.

a. Daily - furnish SWPA best forecast of inflows, pool elevations, and constraints.

b. Try to give at least 48-hour notice of the following conditions:

(1) Time pool will rise into Zone I.

(2) Time pool will fall into Zone III.

c. Daily - obtain SWPA power schedule.

6. Degree of Corps Control. Absolute.

ZONE III

1. Description. Flexible Conservation Zone.

2. Operational Objectives.

a. Exercise best judgment in achieving conservation storage benefits.

b. Allow maximum utilization of power production potential which will not adversely affect other project uses.

c. Supplement flood control potential when possible.

3. Operational Constraints.

a. Exercise minimum amount of constraint on operations based on best judgment.

b. Limit drawdown to maximum of one-half foot per week.

c. Generation should be made at least once every three days.

4. Declaration of Energy Available.

a. Allocation will be plant capacity or estimated inflow plus a maximum of one-half foot of drawdown per week, whichever is less, unless exceeded by firm energy.

5. Frequency of Contact with SWPA.

a. Daily - furnish SWPA with best forecast of inflows.

b. Daily - obtain SWPA power schedule.

c. Weekly - furnish SWPA with recommended maximum energy production.

d. Monthly - furnish SWPA with recommended energy production and discuss production plans at monthly power schedule meeting.

6. Degree of Corps Control.

a. On energy production - normally negotiable.

b. On utilization of specific carry-over storage from Zone II operations - Absolute.

ZONE IV

1. Description. Design Purpose Conservation Storage Zone.

2. Operational Objectives.

a. Operate the project as nearly as possible to meet the design power while recognizing other project uses.

3. Operational Constraints.

a. Cumulative use by competitors for conservation storage must fall within reasonable limits, although seasonal or short-term flexibility may be allowed.

b. Generation should be scheduled at least every three days to replenish the oxygen content of water in the spillway stilling basin.

4. Declaration of Energy Available.

a. Allocation will be the firm energy of the project under current conditions (lake capacities, tailwater elevations, monthly distribution of firm energy, etc.) for the critical hydro period.

b. Declare energy available on a monthly basis according to subparagraph a minus any cumulative over production or plus any cumulative under production since first entering Zone IV.

5. Summary of Contact with SWPA.

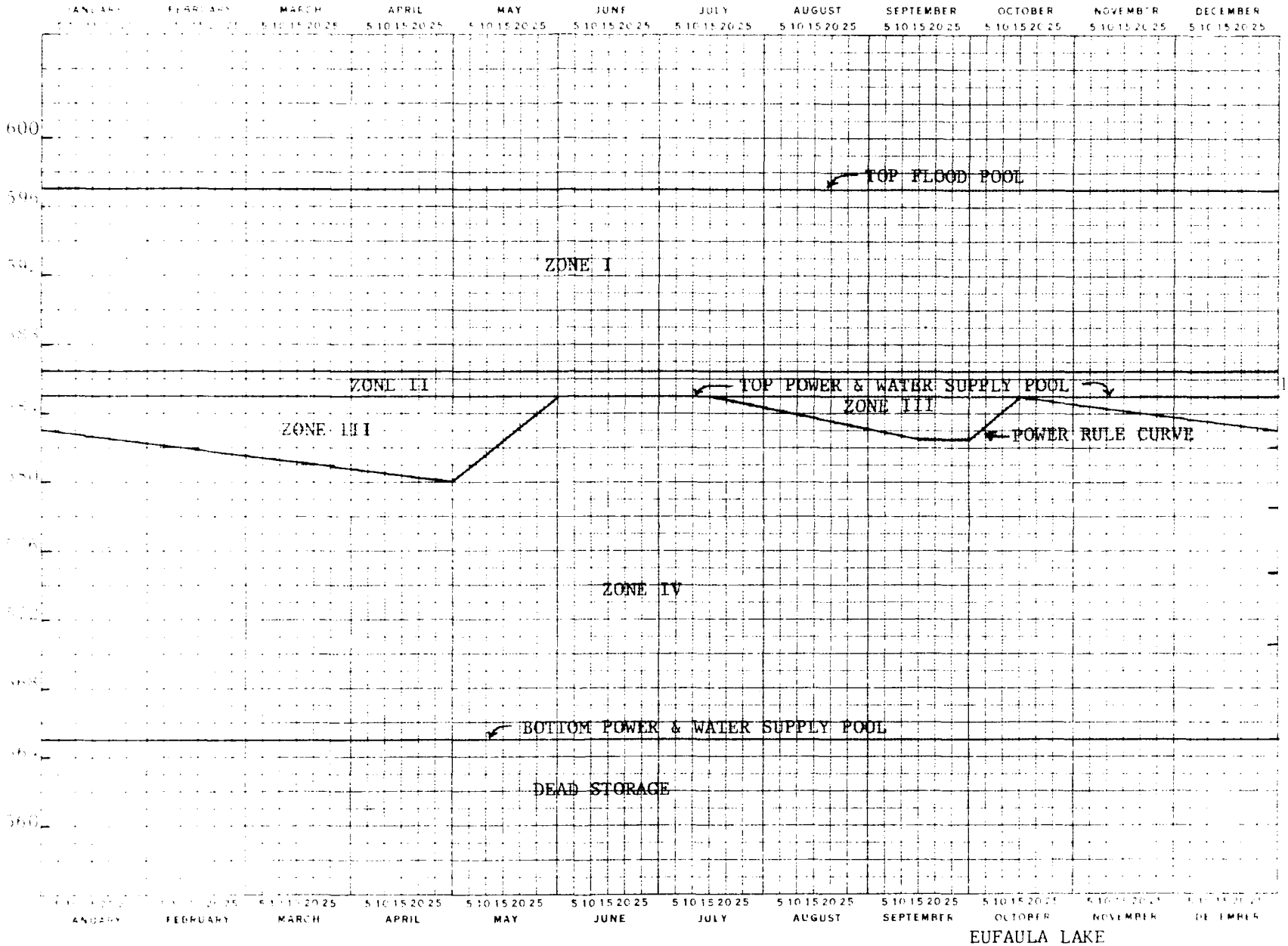
a. Five or more often as needed - furnish SWPA with best forecast of flow.

b. Daily - obtain SWPA power schedules.

c. Monthly - furnish SWPA declaration of energy according to firm or primary capability of the project.

d. Monthly - discuss cumulative deviations of actual generation from firm or primary capability and encourage rectification of this condition.

6. Degree of Corps Control. Negotiable to the extent that the only energy recovered made over and above our allocation would be due to extenuating circumstances such as all possible purchase of power from other sources has been exhausted. Corps would maintain absolute control over minimum releases.



EUFAULA LAKE
OPERATIONAL RULE CURVES

EXHIBIT 2

Minutes

ARKANSAS RIVER BASIN
COORDINATING COMMITTEE MEETING

Dallas, Texas
24 March 1977

1. Introduction. Mr. R. Terry Coomes, Chairman of the Committee, opened the meeting and introduced those in attendance. A list of attendees is inclosed. Mr. Coomes presented a brief review of the topics that would be presented in the meeting.

2. Minutes from 1976 meeting. The minutes were accepted as published in the "Report on 1976 Activities."

3. Review of 1976 operation.

a. Above Fort Smith. Mr. Ross R. Copley, Corps of Engineers, Tulsa District, reviewed last year's operations above Fort Smith. He said that rainfall was below average throughout the basin. The lowest annual flows since 1967 were experienced at the Van Buren gage. About all of the projects were below normal at the beginning of the year. However, most of the pools were filled in April and there was a considerable amount of water stored in the flood pools during this period. During July, heavy rains occurred in southern Kansas. At Elk City, Kansas, the flood was about two times larger than the previous flood of record. The pool level at Elk City Lake reached about one foot above the uncontrolled spillway and water flowed through the uncontrolled spillway for the first time since the lake was placed in operation. After the July floods we were dry for the remainder of the year. Impoundment of water was started at Kaw Lake and diversion was made through the outlet works at Optima and Birch Lakes. The seasonal guide curves for the Kansas projects, Council Grove, Elk City, John Redmond, and Fall River, were continued with slight modifications for fish and wildlife benefits. The proposed guide curves for 1977 have been submitted and are being reviewed. The water supply used during 1976 was about two and one-half times the amount used in 1975. The repair work in the Oologah stilling basin was completed.

b. Below Fort Smith. Mr. David R. Brown, Corps of Engineers, Little Rock District, reviewed last year's operations below Fort Smith. The April rise below Van Buren was mainly from upstream rains. There were no major rises on the Fourche La Fave or Petit Jean Rivers during the year. To give an idea of the flows originating below Van Buren the rainfall was about eight inches below normal at Fort Smith and six inches below normal at Little Rock. Last year was the best one on the navigation system since it was placed in operation.

About 7.1 million tons were moved on the waterway. This was a 37 percent increase over 1975. The Little Rock District dredged 1.9 million yards of material in 1976. A significant amount of this dredging was in the lower 10 miles of the navigation channel along the White River. This reach was influenced by the extremely low flows on the Mississippi River. The only major construction going on is the highway bridge across Lock and Dam No. 13. There have been several lawsuits filed as a result of the high water during 1973 and 1974. During the year, the recreation usage of the river increased.

4. Plan of Regulation for Arkansas Basin - 1977. Mr. Charles H. Sullivan, Corps of Engineers, Southwestern Division (SWD), discussed the Arkansas River Basin System study for water control. A series of slides were presented showing some of the different regulating schemes that had been studied and a comparison of the results of each one. A rule curve for the target flows at Van Buren was presented. The target flows would be a function of percent of basin storage used and time of year. The percent of basin storage is defined as the percentage of storage currently in Kaw, Keystone, Oologah, Lower Grand River, Tenkiller, Eufaula, Hulah, and Wister Lakes, plus five days of predicted inflow to these projects. A feature of all the plans presented was a navigation taper which would provide flows in the range of 20,000 to 40,000 cfs for about three weeks to allow time to dredge shoals that form in the navigation channel during high flows. Some of the items used in comparison of the various plans studied are flood damages prevented, number of times pools would be filled, damage in the pool area, impacts on recreation, dredging costs, costs to navigation and effect on hydropower. We are currently revising the Master Water Control Manual for the Arkansas River Basin downstream from Great Bend. This manual will contain the system water control plan for the basin.

5. Navigation Activities. Mr. Paul N. Revis, Corps of Engineers, Little Rock District, presented a slide talk on the navigation activities on the McClellan-Kerr Arkansas River Navigation System. A brief overview of the facilities and history of beginning of operations was presented. During the few years of operation we have seen a gradual increase in the horsepower of tows operating on the system. The largest one regularly operating on the river now has 5600 horsepower. This one usually pushes eight barges.

Port facilities have also increased. In addition to the major ports like Little Rock, Muskogee, Catoosa, etc., there are about 70-75 private terminals. He pointed out that the Corps and Coast Guard jointly publish a channel report to users showing channel depths and condition based on reconnaissance surveys performed by the Corps.

The traffic on the river is affected by high flows. When the flows were high during the floods, traffic dropped off in relation to the flow.

There have been some navigation problems on the lower 10 miles of the White, resulting from the low Mississippi and White River flows.

There have been very few maintenance problems. The main maintenance efforts have involved dredging to maintain the design channel dimensions. The navigation taper is important in the maintenance of the channel because of the time it provides to identify the shoals and get the dredges into position. The bank stabilization is essentiallly complete on the system. The Tulsa District has been setting out some willow trees to provide stabilization where the erosion is not severe enough to require stone. Development of recreational areas is continuing. When this is complete there will be over 100 parks.

6. Status of Automated Data Collection for Operation of the System. Mr. Ross R. Copley said that in 1973 they contracted with E.G.&G in Albuquerque, New Mexico, to design an automated hydrologic data collection system. This was needed to provide "real-time" data on a day-to-day basis for operation of the projects in the Arkansas Basin. The manual methods of collecting and processing the large amounts of data required for operating this system of projects are too slow. E.G.&G came up with a four-part system consisting of the remote gaging stations, communication system, data acquisition and processing system, and distributed color display system. Several types of communication systems were looked at; however, the telephone system was chosen as the best at this time. A design memorandum has been submitted to the SWD office and the Office of the Chief of Engineers. We are in the process of upgrading the gaging stations now. The plans and specifications for the system are currently being prepared. These should be ready by the time the project is approved by the Office of the Chief of Engineers. There may be some delay in implementation of the system due to restrictions on funds during this fiscal year.

7. Operational Arrangement between Southwestern Power Administration and Corps of Engineers and Declaration of Energy at Corps Power Projects.

a. Corps of Engineers viewpoint. Mr. James G. Dalton, Corps of Engineers, SWD, presented a discussion on operational agreements affecting hydropower production from the viewpoint of the Corps of Engineers. This discussion included the need for operational agreements and some background on the agreements beginning with a look at the electric power industry, the capability of Corps projects, and how to best fit our power features into the electric power load while balancing the projects operation for equitable benefits to other project purposes.

Daily and seasonal load shapes for the southwest region were discussed and the importance of peaking capability was stressed. Hydropower plays an important role in meeting peak load requirements because of its flexibility. The capability of the Corps projects to produce hydropower is a function of the inflow and the available head. Since the inflow to these projects is variable, storage space is required to

coordinate releases for power production with the demand. The amount of storage limits the average release or demand which can be met during drought periods and the amount of storage space, at any site, that can be allocated to hydropower is limited by costs, topography, and other project purposes. Studies have been made to determine the "firm energy" that can be produced at each project. This "firm energy" is the amount of energy, on an annual basis, that can be produced during the critical drought of record.

An example of zoning of the pools was presented. These zones represent levels at which the priorities for various project purpose operations change. Consequently, different rules have been developed for project operation in each of the zones. An accounting procedure was presented for comparing actual generation with the firm energy potential during drought periods. Monthly power schedule meetings between the Corps and the Southwestern Power Administration (SPA) were discussed.

b. Southwestern Power Administration Viewpoint.
Mr. Kendall K. Kerr, SPA, Tulsa, Oklahoma, presented a review of responsibility of SPA in marketing the hydropower from the Corps projects. SPA was established by the Department of the Interior to market hydropower from Federal projects in the States of Missouri, Arkansas, Louisiana, Kansas, Oklahoma, and Texas. Section 5 of the 1944 Flood Control Act authorizes the Department of the Interior to market surplus electric power and energy from Federal reservoir projects and transmit and dispose of that energy over a widespread area at the lowest possible rate consistent with sound business principles.

Mr. Kerr pointed out that during a dry year only about one-half of the contracted energy they are presently marketing can be provided by the Corps projects. The rest has to be met through banking arrangements or thermal purchases. SPA has a responsibility to provide this energy once it has been marketed, even though it may not be available from hydropower under adverse conditions.

When they are involved in the marketing program such things as economic optimization, customer needs, dependability of generating equipment, freedom to generate when needed, and availability of non-hydro energy are considered. Operational considerations are also involved in scheduling hydropower. This includes such things as weather, pool levels, system balance, current inflow and trends, load requirements and, when possible, other project purposes. Also, variation in customer needs, outages, transmission restraints, etc. Based on these considerations, SPA determines a short and long-term basis when to supplement hydroelectric generation with thermal, how much to purchase considering cost and availability, and priority of use of system projects. The Corps is taking a greater interest in these operations and in the future it appears that there will be closer coordination of the Corps plans and SPA's plans. There is a monthly meeting for review of the plans for each month.

He also presented some slides showing the system configuration and some guides for hydropower production.

8. Van Buren Channel Capacity Studies. Mr. Ross Copley presented a discussion of the status of these studies.

We have been looking at the problem at Van Buren for the past few years and presently a report is being finalized for review by the Division office, SWD, and the Chief of Engineers. The report should be submitted to SWD next week. The Van Buren reach is the subject of quite a bit of litigation and there are several legal questions involved that haven't been resolved.

The problem stems from the fact that in past history the channel capacity at Van Buren has fluctuated widely but has been reduced significantly in the more recent years. The impact of operating the upstream system of reservoirs for the reduced channel capacity is to reduce the flood protection provided by the system for large floods. The system fills on an average of about once every 10-15 years when operating for a release rate of 150,000 cfs through the Van Buren reach. The impact of operating for a reduced channel capacity of 105,000 cfs is to increase the frequency of filling these projects to about twice as often.

A slide showing the area inundated through the Van Buren reach in recent times by a discharge of about 150,000 cfs was presented. This showed that there is quite a bit of land inundated outside of the present channel limits. However, most of the area flooded is land that formerly was in the river bottom. Although the land inundated is in private ownership, it has received considerable benefit from the project overall through construction of cutoffs such as in the Braden Bend area, or has actually accreted behind dikes constructed by the Corps such as the area just upstream from the mouth of the Poteau. Even though the duration of inundation of these lands may be longer during some rises, there is a question as to whether there has been a net benefit to these areas.

Various alternatives ranging from structural solution to acquisition have been studied but legal questions have not been resolved. The studies to date show that any structural solution would be very costly and there would be considerable questions concerning the possible impacts on navigation.

9. Summary and Discussion. Mr. Randy Young, Arkansas Soil and Water Resources, Little Rock, Arkansas, brought up a question of having the White River Basin included in this committee. The need for a committee on the White River Basin was recognized, however, it was agreed that the problems represented are different than those affecting the Arkansas. There would also be several members on the Arkansas Committee that would not have an interest in the White Basin.

Inclusion of the White Basin would involve several interests from Missouri and Arkansas that are not involved in the Arkansas Basin problems.

Tentative plans are to have the meeting in Dallas again next year.

The minutes of this meeting are to be furnished in draft form for review and will be published in the 1977 report.

1 Incl
as

Attendance List

ARKANSAS RIVER BASIN
COORDINATING COMMITTEE MEETING
24 March 1977
Dallas, Texas

COMMITTEE MEMBERS

R. Terry Coomes	Corps of Engineers, SWD, Dallas, TX
J. R. Young	Arkansas Soil & Water Resources, Little Rock, AR
Kendall K. Kerr	Southwestern Power Administration, Tulsa, OK
Kenneth B. Schroeder	Department of the Interior, Albuquerque, NM
Arthur Martin	Federal Power Commission, Fort Worth, TX
Larry M. Sheets	Kansas Water Resources Board, Topeka, KS
Terry Thurman	Oklahoma Water Resources Board, Oklahoma City, OK

OTHERS

Charles H. Sullivan	Corps of Engineers, SWD, Dallas, TX
John R. Parks	Corps of Engineers, SWD, Dallas, TX
James G. Dalton	Corps of Engineers, SWD, Dallas, TX
Willard H. Rusk*	Corps of Engineers, SWD, Dallas, TX
David R. Brown	Corps of Engineers, Little Rock District, Little Rock, AR
Paul N. Revis	Corps of Engineers, Little Rock District, Little Rock, AR
Ross Copley	Corps of Engineers, Tulsa District, Tulsa, OK
Guy Cabbiness	Corps of Engineers, Tulsa District, Tulsa, OK

*Part-time

EXHIBIT 2
Page 2 of 8

Tentative Agenda

ARKANSAS RIVER BASIN COORDINATING COMMITTEE MEETING
Main Tower Building, 1200 Main Street
Dallas, Texas
24 March 1977

I.	Introduction	8:00 a.m.
II.	Minutes from 1976 meeting	
III.	Review of 1976 operation	
	a. Tulsa District b. Little Rock District	
IV.	Plan of Regulation for Arkansas Basin - 1977	
V.	Navigation Activities - Growth in Traffic, Maintenance Problems, Associated Recreation	
VI	BREAK	
VII.	Status of Automated Data Collection for Operation of the System	
VIII.	Operational Agreements between Southwestern Power Administration and Corps of Engineers at Power Projects	
IX.	LUNCH	11:30 - 12:30
X.	Van Buren Channel Capacity Studies	
XI.	Summary and Discussion	
XII.	Adjourn	2:00 p.m.